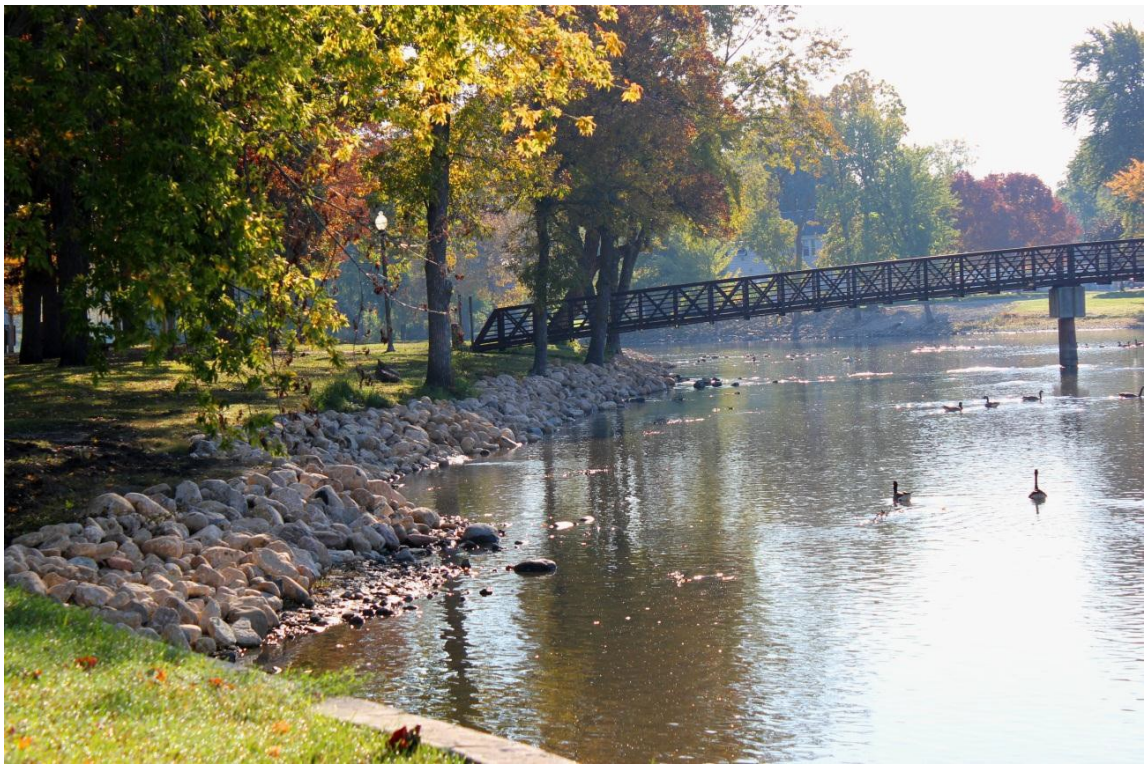
PUBLIC TREE INVENTORY REPORT AND MANAGEMENT PLAN

FOR THE

CITY OF BURLINGTON, WI



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Public Tree Inventory Report &Management Plan
For the City of Burlington, WI
By: Wachtel Tree Science (262)538-1900 (December, 2013)

EXECUTIVE SUMMARY

The City of Burlington recognizes the benefits a properly maintained urban forest provides to the quality of life of its citizens, through air pollution reduction, energy conservation, increased property values and aesthetics. To develop a system to increase these benefits through effective management, the City contracted with Wachtel Tree Science to conduct an urban forest inventory update and from that data, develop a management plan.

This document reports the findings of the street and park/municipal property tree inventory that was conducted between July 15th and August 22nd of 2013 by Wachtel Tree Science staff. The results include:

STREET TREES

- A total of 3,393 planted sites, 9 stumps and 398 potential planting sites were inventoried along City of Burlington street right-of-ways.

- The current street tree population is 89.5% of full stocking (existing trees/identified planting sites)

- 65 different species and 33 genera make up the street tree population, with the species Norway Maple (33.4%), all Ash (19.3%), and Honeylocust (9.0%) occurring most often. The top two *Genera* include: *Acer* (maples) 53.0% and *Fraxinus* (ashes) 19.3%.

PARK/MUNICIPAL PROPERTY TREES

- 1,073 planted sites and 4 stumps were inventoried at various City parks as well as other public properties and facilities.

- 58 different species and 34 genera make up the park/municipal property tree population, with all Ash (14.5%) and Norway Maple (8.4%), occurring most often. The top three *Genera* include: *Acer* (maples) 20.3%, *Fraxinus* (ashes) 14.5% and *Picea* (spruces) 9.3%.

ALL PUBLIC TREES

- The City of Burlington's public tree inventory shows a moderate aged tree population, 52.5% of the trees are in the 7-12" or 13-18" diameter classes. 23.5% of the trees are in the smallest diameter classes (1-3" and 4-6"), while the largest diameter classes make up the remaining 24% of the population.

- The distribution of size classes is close to the desired "bell-shaped" curve for an urban tree population. 60 to 70% of the public trees are contained in the 7-12", 13-18", and 19-24" classes respectively.

- Of the younger trees (1-12” in diameter), 81% of the population in this diameter range are in one of the top three condition classes (70% or above). With the larger trees (13"+ in diameter) 48% are in a condition class at or above 70% and 52% are below the 70% condition class. Many of these larger diameter trees that fall in the below 70% condition class are Green Ash and Norway Maple that have co-dominant stems and included bark resulting in poor structure.

GENERAL OBSERVATIONS

- Total public tree value is estimated is $5,301,539.95. This equates to an average value of $1,187.09 for each inventoried tree along the City’s streets, in parks and other public properties.

- The City is over planted with the Maple species *Genus* (*Acer*). This *Genus* alone accounts for 43.0% of the entire public tree population. *Fraxinus* (Ashes) are at 18.4%. This percentage will change with enactment of the “5-year Emerald Ash Borer Implementation Plan” (separate document).

- It is imperative that new species continue to be introduced to increase diversity and a moratorium be placed on the planting of any more Maple or Ash species.

- Being a moderately-aged urban forest, a resource of this magnitude justifies increased expenditures for providing properly managed care.

- The current level of local funding is not sufficient to manage the existing public trees for the foreseeable future, especially as the City implements more components of their Emerald Ash Borer (EAB) management strategy.

- The City should have someone with an International Society of Arboriculture Certified Arborist credentials on staff by 2015. The arborist along with the horticulturist currently on staff will help with the management and coordination of the various public forestry functions within the City.

- The City needs to retain local nursery stock suppliers and installers that practice proper structural pruning techniques in the nursery, so the City receives high quality planting stock thereby reducing the amount of staff time devoted to *Training Pruning* early in the trees development growth phase. This is extremely critical if an ash removal/replanting plan are implemented.

- The development of comprehensive planting specifications and timely inspection oversight needs to be instituted by the City for contracted plantings. The City needs to also take a more proactive role in demanding greater species diversity when developers submit their planting plans for approval.

Policy recommendations, maintenance schedules and budget requirements are outlined in the included management plan to assist the City of Burlington in both short and long term municipal tree maintenance planning.

INTRODUCTION

Trees give some of the first impressions of the City of Burlington to visitors and add intangibles to the everyday lives of its citizens. Trees add beauty to the City of Burlington through the softening and complementing of building's architecture and creating a pleasant environment. Trees improve the quality of life now and will continue to do so in the future, provided they are managed to their fullest potential.

A well maintained and managed urban forest has a lot to offer the citizens of the City of Burlington. Trees improve the environment and the quality of citizen's lives every day.

Energy savings are well documented. Trees planted around a home can reduce cooling costs by up to 30%, up to $250 in savings per home per year. Windbreaks aid in reducing winter heating bills. Our comfort is greatly affected by trees. Proper tree placement can reduce solar radiation (creating shaded areas), focus air movement, and lessen air temperature (offsetting the urban "heat island" effect).

The quality of the air around us is improved by trees. One acre of full-grown medium-sized trees removes up to 2.6 tons of carbon dioxide each year and produces enough oxygen for 18 people for a year. Trees trap dust particles and absorb a great variety of harmful gases. The proper placement of trees can reduce noise and pollution to more tolerable levels.

Trees play an important role in reducing soil erosion, runoff and providing storm water treatment. Trees intercept falling raindrops, resulting in less runoff, while green spaces encourage infiltration, lowering runoff volumes. Trees taking up water through their roots, take up nutrients that can harm water quality.

Trees improve recreation opportunities by providing comfortable, inviting parks for a variety of activities. They create wildlife diversity in the City of Burlington by providing habitat for birds and small animals that otherwise would not be present.

The urban forest increases economic stability by helping to attract and keep businesses. The National Arbor Day Foundation has reported that people will linger longer in shaded shopping areas. Properties rent faster and have fewer turnovers in areas that are well stocked with trees. Studies by the USDA – Forest Service, show that trees can add 10% or more to property values. It is a fact that people will pay more for a property with trees.

The City of Burlington's urban forest can add great value to the community, but it can also be a liability or hazard if not taken care of. Trees that are not managed can fall apart in storms, damaging property and interrupting electric and telephone service. These same trees can pose a risk to people. The City of Burlington needs to plan so the best suited trees are planted. No management is an option that always costs more in the long run.

The public trees in the City of Burlington are owned by every citizen. Most other public investments a community makes, depreciate in value. By investing wisely in trees, values increase for both present and future generations.

I. INVENTORY METHODOLOGY

A. Inventory System

A street/park/municipal property tree inventory was conducted along all City streets, within City parks, and at various other public buildings and facilities.

Field data was collected utilizing a handheld pocket computer, loaded with ESRI's **ArcPad 10.0** software. Digitized orthophoto and planimetric mapping data were supplied by the City of Burlington through their consulting engineer Kapur and Associates, Inc. Detailed site information was collected using a custom data entry interface **PinPoint 2.0**. A tree inventory database of all inventoried public trees was created in Microsoft **Access 2003** utilizing reports, tables and queries customized by Wachtel Tree Science. All trees and potential planting sites in the public R-O-W of the City were inventoried per street mapping supplied by the City.

The following information was collected between July 15th and August 22nd of 2013 in a detailed walking inventory.

B. Public Tree Site Information

1.) Tree/Vacant Grow Space Unique ID number

2.) Inspection Date (date record was created or updated)

3.) Address (House Number)

4.) Street Name (the street that corresponds to the Address)

5.) Park/Public Property Name

6.) Growth Space (treelawn/terrace width)
- 1 = Open/Unrestricted
- 2 = Terrace w/ Sidewalk 0 – 3'
- 3 = Terrace w/ Sidewalk 3 – 5'
- 4 = Terrace w/ Sidewalk 5'+
- 5 = Boxout/Cutout
- 6 = Ditch
- 7 = Median

C. Public Tree Data Collected

1.) Species: see **Appendix A** for listing of species inventoried.

2.) Year Planted: i.e. 2010, 2011, etc. (Data to be inputted by City personnel)

3.) DBH: tree diameter measured at 4.5 feet above ground, rounded to nearest inch. With multi-stemmed trees, the largest stem was used as the basis for measurement.

4.) Height Class: 0-15', 15-30', 30-60', 60+

5.) Deadwood Present: 0 – 100% (5% increments)

6.) Condition Rating: 0 – 100% (5% increments)

This is an overall rating of factors covering tree health and structure including: branching, condition of trunk and roots, decay, vigor, insect and disease problems, growth rate, crown development, life expectancy, etc.

0%	Dead tree or vacant planting site.
<30%	Trees in poor condition, death likely within three to five years. Trees with this rating usually have some major defect or are at the end of their life cycle.
31-50%	Trees with major structural problems and/or in poor health. The trees could live five to ten years but are likely to decline further and be damaged in storms.
51-70%	Trees with minor structural defects and little signs of poor health. These trees will benefit the most from proper care (pruning, mulching etc.) especially young trees. Most trees in this class can be expected to live ten or more years.
71-90%	Trees with good form and health. They may have some minor problems but they would be easily corrected with proper maintenance. These trees are established in their site and could be expected to live 20 or more years.
90%+	Trees in excellent health with no structural defects.

7.) Maintenance Needs:

1 = PLANT: plant vacant space.
2 = REMOVE: tree needs to be removed.
3 = SAFETY PRUNE: tree needs to be pruned for safety reasons.
4 = ROUTINE PRUNE: no immediate needs, tree should be on regular pruning schedule.
5 = TRAINING PRUNE: generally a young tree (up to 10" DBH) that needs pruning to direct scaffold branch structure and future form.
6 = WATCH: trees needs to be checked yearly due to structural or health problems. Conifers should be checked every 5 years to ensure they are not outgrowing their spaces and causing sight obstruction or clearance problems.
7 = CABLE & PRUNE: tree needs bolt and/or cable and pruning to correct a structural defect.
8 = GIRDLING ROOT: tree has girdling root(s) that need to be removed.
9 = REMOVE STUMP: stump that needs or may need to be removed.
10 = REMOVE STAKES: planting or support stakes that need to be removed.

11 = HEAVING WALK/CURB: tree roots or root flare is damaging pavement.

8.) Work Priority:

A numbering system to assist in prioritizing work that needs to be completed

1 = OK: No problems. Also designation for vacant planting sites.

2 = PRIORITY 1: Work that needs to be completed in the next year for safety reasons (removals, cabling, safety pruning) or tree health.

3 = PRIORITY 2: Work to be completed over the next 2 - 3 years that is currently not presenting a major hazard but will prevent future problems (clearance, deadwood or training pruning).

4 = PRIORITY 3: Work to be completed over the next 5 - 7 years so the problem does not become a hazard. Or monitor the tree to be sure the condition does not become worse (crown restoration, crown cleaning or rejuvenation pruning).

10.) Clearance for Street Trees:

1 = OK: no clearance problems.

2 = Traffic: tree branches are or soon will be struck by passing vehicles.

3 = Signs/Lights: tree is interfering with street lights or street signs.

4 = Walks: tree limbs/branches are interfering with pedestrian traffic.

5 = Potential View Obstruction: tree may be obstructing the view of traffic.

11.) Utilities Present Overhead:

1 = none

2 = electric

3 = telephone/cable

4 = both

12.) Special Conditions: (see **Appendix G**)

Any specific information about a particular tree that was inventoried (i.e. disease or insect problems, multi-stemmed, included bark, wounding, v-crotch, etc.).

13.) General Notes/Comments

II. INVENTORY RESULTS AND DISCUSSION

A. Street Tree Inventory

The City of Burlington's street tree population consists of 3,393 street trees, 9 stumps, and 398 potential planting sites for a total of **3,800** sites inventoried.

1. Data Summary

Total stocked sites (includes stumps)	3,402	(89.5 % stocking)
Potential planting sites (vacant)	398	
Removals	110	
Safety prune	396	
Routine prune	1,947	
Training prune	879	
Tree heaving walk/curb	1	
Watch	39	
Cable/prune	10	
Girdling root	0	
Remove stakes	11	
Remove stumps	9	
Prune for street clearance	3	
Prune for sign/light clearance	8	
Prune for walk clearance	39	
Potential view obstruction	15	
Maintenance Priority		
OK	398	
Within Next Year	536	
Within Two to Three Years	879	
Within Next Five Years	1,987	

2. Planting Site Summary

There are 398 potential planting sites within the street tree inventory area that meet the criteria for being a suitable planting site. Some of these sites may be impacted by underground utility conflicts which may prohibit planting within the public R-O-W. All of the sites are open/unrestricted, or have growing space of 5 feet or greater:

Open/Unrestricted	208	(79%)
Terrace w/ Sidewalk 5'+	190	(16%)

This larger width creates many options when selecting species to plant and is a feature that many municipalities do not have. The larger planting areas in these sites will allow a wider variety of trees to be planted and will help the City of Burlington to have healthier trees.

In all, 3,402 (89.5%) of the 3,800 street tree sites in the inventoried areas have trees or stumps (stocking level). This is a much higher stocking level than for most of the communities we have surveyed. The norm is in the 50 to 60% stocking level.

Emphasis should continue to be placed on new tree plantings, continuing to use greater species diversity in the planting site selection process. Since stocking is at a higher than average level, an opportunity presents itself in allowing superior species to be planted as planting monies become available and undesirable species are removed from the street tree population.

3. Species Frequency

Providing for species and age diversity in the urban forest are the two most significant ways to reduce the impact of a destructive pest or disease. Dutch elm disease should have taught us this lesson, but we weren't listening. The current rule of thumb is **"no more than 30% of one family, 20% of one genus and 10% of one species**." The DNR, University of Wisconsin and urban forestry profession representatives have recently provided the following recommendation to consider in striving for greater species diversity. **"No more than 20% in one family, no more than 10% in one genus and no more than 5% of any single species, including cultivars and varieties."**

Shown below is an example of how this works:

Plant no more than 20% of a family: i.e. **Aceraceae** (Maple Family)

Plant no more than 10% of a genus: i.e.

1. ***Acer*** × *freemanii* (Autumn Blaze Maple)
2. ***Acer*** *rubrum* (Red Maple)
3. ***Acer*** *platanoides* (Norway Maple)
4. ***Acer*** *miyabei* (Rugged Maple)
5. ***Acer*** *saccharum* (Sugar Maple), etc.

Plant no more than 5% of a species: i.e. *Acer* ***platanoides***

Optimally, try to have the greatest diversity of species that can be managed. Start planning now for a more diverse urban forest. Finding a wider variety of species will be harder and more expensive, but it is worth it. Work with local nurseries to come up with innovative solutions. Educate policy makers on the necessity to do it right, not fast and cheap. In the long run this will save money, time, and effort and the benefits a healthy, sustainable urban forest provides.

The 3,393 existing street trees (3 are shrubs) include 33 genera and 65 different species. The top nine Species break down as follows:

Acer platanoides	Norway Maple	1,132 trees	33.4%
Fraxinus pennsylvanica	Green Ash	382 trees	11.3%
Gleditsia triacanthos inermis	Honeylocust	306 trees	9.0%
Fraxinus americana	White ash	271 trees	8.0%
Acer saccharinum	Silver Maple	202 trees	6.0%

Acer freemanii	Freeman Maple	163 trees	4.8%
Acer saccharum	Sugar Maple	150 trees	4.4%
Acer rubrum	Red Maple	149 trees	4.4%
Tilia cordata	Littleleaf Linden	147 trees	4.3%
	Total	2,902 trees	85.6%

See **Appendix B**, Species Frequency-All Public Trees, for the entire break down.

It is unfortunate to see that seven of these nine species break the most recent recommendation of the "10% Rule for **Genus**". Five species are the genus *Acer* (Maples) and two are *Fraxinus* (Ashes). It is imperative that more species on the recommended street tree species list be planted (see **Appendix C**). With the two genera *Acer* 53.0% (Maples) and *Fraxinus* 19.3% (Ashes) making up such a large portion (72.3%) of the population, any problems with one of the species within its respective genus will have a big impact on the City of Burlington's urban forest and budgets. This has already become evident with the discovery of Emerald Ash Borer (EAB) in the City. No one genus should make up more than 10% of the population.

There is one additional genus that needs to be monitored closely so that it does not exceed the 10% threshold. *Gleditsia* (honeylocust) is currently at 9.0% of the street tree population.

All future planting projects need to focus on adding more diversity and quantities to the species mix. Several additional species to consider adding to the planting list include: Amur Corktree and Swamp White x Bur Oak hybrid. Species that could be increased in numbers planted annually include: hybrid Elm species, Yellow Buckeye, Turkish Filbert, Ironwood, Ginkgo, Serviceberry, and Kentucky Coffeetree.

A concern with Ash species (Green, White and European) combined total 665 trees or 19.6% of the street tree population) is the number of disease and insect problems they can contract other than EAB. Although most of these will not cause the tree's demise, they can be a nuisance. Native ash borers, flower gall mites and plant bugs are the most common insect pests of Ash, while anthracnose and ash yellows lead the list of diseases.

The biggest threat to the native ash population is Emerald Ash Borer (EAB). This is an exotic woodborer that was found attacking and killing ash trees in Michigan during 2002. Since its detection, EAB has killed millions of ash trees and is now found in Connecticut, Colorado, Georgia, Illinois, Indiana, Iowa, Kansas, Kentucky, Massachusetts, Maryland, Minnesota, Missouri, New Hampshire, New York, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, West Virginia, Wisconsin and Quebec and Ontario provinces in Canada. EAB is easily spread through the movement of firewood, logs and nursery stock. EAB was confirmed in Burlington on 07/30/2013 by the Wisconsin Department of Agriculture, Trade and Consumer Protection (DATCP).

Now that EAB has arrived and is expanding in Wisconsin, the DATCP is determining the extent of infestations as they are discovered, quarantining the affected areas, and assisting

with developing plans of action based on the size of the infestation; available support resources are limited. Removal will most likely be the responsibility of municipalities and private residents per their local ordinances.

It is recommended that a minimum five year moratorium be placed on future Ash plantings until the full impact of this pest is better understood. Burlington's EAB strategy is outlined in their recently completed "5-Year EAB Implementation Plan".

With Norway Maple having an extremely high frequency (33.4%), the concern of their tendency to develop girdling roots is a major maintenance issue currently. 567 of the 1020 existing street Norway Maples are 15" DBH or less. Girdling roots are a combination of a nursery problem and a characteristic of the species. The girdling roots tend to kill the trees about 30 - 35 years after planting, just as the trees are getting nice sized. This species because of its opposite branching habit has the propensity to develop co-dominant stems and included bark. If left unchecked by not performing timely training pruning when the trees are young, serious structural issues can develop. Weak branch unions lead to this species being more susceptible to large branch failure in storms. They also can become invasive through seed dispersal and germination in unwanted areas. For these reasons, Norway maples are not highly desirable street trees.

Conifers account for (40 trees) 1.2% of the population. A majority of these trees are located on street medians or streets where there is no sidewalk and have been planted by the abutting property owner in the right-of-way. Conifers should not be used for street trees because of view and clearance obstructions in most street settings. None of these trees are currently creating obstructed view potentials or clearance issues.

Another concern is Silver Maple, which make up (202 trees) 6.0% of the total population with 114 being 20" DBH or larger. This is a poor street tree because it is very weak wooded, grows with a poor form and has surface roots. There is a higher probability of storm damage due to their very poor form. This is not a recommended species and extra focus will be needed on these trees (**Appendix C** lists undesirable as well as desirable trees).

It is important to continue the planting of trees with mature heights of 30 feet or less. Currently there are 185 trees or 5.5% of the current population in this grouping. Some smaller scale trees to add to mix include: Korean Mountain Ash and more Turkish Filbert, Ironwood, Serviceberry, American Hornbeam and crabapple. These are important to use in areas with power lines where shorter trees are preferred or in smaller growspaces (< 5' between the back of curb and sidewalk). Disease resistant varieties of crabapples with persistent fruit should be specified for any new plantings.

4. Street Tree Planting

The minimum criteria for potential planting sites was where there was existing curb and gutter and sidewalk with a minimum terrace width of 6 feet. A vast majority of sites in the City had terrace widths of six feet or greater or were unrestricted, meaning there was

no sidewalk on the back side of the planting site. Given the moderate number of qualifying potential planting sites (398) within the City, planting is an important component in the overall urban forest plan. Proper species selection is a key to reducing future problems and costs. **Appendix C** contains a list of recommended trees and ones to avoid. With all of the open growth space (planting) areas being *Greater than 5'* in width or *Unrestricted* allows for more choices in species and healthier plants due to larger root zones.

When planting, it is best to plant trees of the same species in groupings or using mixed species with similar mature size and growth habit. Alternating species every other tree can create a checkerboard effect that is not very attractive as the trees mature. By planting in groups of three to five or when feasible entire blocks, the desired effect of the plants will be achieved. Also, when possible, plant in the back half of the R-O-W to protect from vehicular and road salt damage. This is particularly important with unrestricted locations when those areas are chosen for planting in the future. The City is also trying to determine locations in the City where new trees can be planted behind the sidewalk.

The following modifications are recommended to be incorporated into the "Trees, Standards Related to Planting and Care Policy".

- continue the moratorium on the planting of Ash species for at least another 5 years (due to insect threat being present - Emerald Ash Borer - and being too high a percentage of the population)
- eliminate the planting of Norway Maple as well as all other *Acer* species since the *Acer* genus already is 53% of the street tree population
- where Crabapples are planted, select disease resistant and smaller persistent fruiting varieties, add more varieties to the mix.
- under power lines, plant only trees that are small at maturity
- where possible, (especially in new areas or where there can be a lot of mortality) add groups of new species that are currently not being used to any great extent, more variety in species is needed
- discourage planting of Spruce and Pine varieties in the R-O-W by abutting property owners

Early care is important. Trees will need watering for a two to five year period (depending on how bad the dry periods are, the longer the drought, the more the trees will need to be watered). Water is probably the single most important limiting factor to establishment and good growth in our harsh urban environment.

Pruning after the trees are established (*Training Pruning*) is also very important. Try to visit newly planted trees every three years up until they are 8" in diameter. This will ensure that proper structural pruning is taking place. What can be taken off a tree with a hand pruner or handsaw in year three will need a chain saw in year 15. It is not only more expensive but is also more stressful on the tree to wait. Early training pruning will go a long way to reduce costs and provide a safer urban forest by directing future growth.

B. Park/Municipal Property Tree Inventory

A total of (21) established parks were inventoried in the City of Burlington. The named parks include: Beaumont Field/Congress Field, Benson Park, Beverly-Jo Park, Devor Park, Echo Park, Festival Grounds, Grove Street Park, Hintz Complex, McCanna Park1, Meinhardt Park, Nestles Park, Riverfront Park, Riverside Park, St. Mary's Park, Steinhoff Park, Sunset Park, Wagner Park, Water Tower Park, Wehmhoff Jucker Park, Wehmhoff Square, and Westedge Park.

The following public areas were also part of this inventory: Fire Department, City Hall/Police, Dog Park, Wastewater Treatment Plant, Old Wastewater Treatment Plant, Standpipe, Old Water Tower, Bayridge Lift Station, Liberty Drive Lift Station, Krift Street Lift Station, Well #7, Well #8, Well #9, Well #10, and Well #11. The new Public Works Facility was not inventoried due to the newness of the complex and the fact that the most current orthophotography shows the site as agricultural land. With the next planned fly-over for aerial photography in 2015, the newly planted trees on the site can be added to the GIS at that time.

A total of **1,077** sites were inventoried which includes **4** stumps.

1. Data Summary

Total trees (includes stumps) 1,077
- Removals 31
- Safety prune.....165
- Routine prune 499
- Training prune 132
- Watch.....241
- Cable/prune.....0
- Girdling root 0
- Remove stakes 5
- Remove stumps 4
- Maintenance Priority
  - Within Next Year 205
  - Within Two to Three Years.....133
  - Within Next Five Years.....739

2. Species Frequency

The 1,073 existing park/municipal property trees are made up of 58 different species and 34 genera. The top five break down as follows:

Fraxinus pennsylvanica	Green Ash	104 trees	9.7%
Acer platanoides	Norway Maple	90 trees	8.4%
Thuja occidentalis	Northern White-cedar	63 trees	5.9%
Acer saccharinum	Silver Maple	62 trees	5.8%

Fraxinus americana	White Ash	51 trees	4.8%
	Total	370 trees	34.6%

See **Appendix B- All Public Trees Species Frequency**, for the entire break down.

It should be noted that combining all the species in their respective genus puts the *Acer* (Maple) genus at 20.3%, *Fraxinus* (Ashes) at 14.5% and *Picea* (Spruces) at 9.3%. This means that two genera are breaking the currently recommended "10% Rule for **Genus**" where no one species should make up more than 10% of a public tree population. Many of the spruce and arborvitae are used as screening hedges within various park/public properties. That being said, more of other genera, species and varieties on the recommended street and park tree species list need to be planted (see **Appendix C**). With only three genera making up such a large portion (44.1%) of the park/public property population, any problems with one of these genera will have a big impact on the City of Burlington's park/public property landscapes. This is already occurring with Ashes due to the beginning of an Emerald Ash Borer infestation in the City. Staff realizes this lack of species diversity and is working on creating greater species diversity in the future.

More of other species such as hybrid Elm, Kentucky Coffeetree, Serviceberry, Ginkgo, White Fir, Baldcypress, Yellow and Ohio Buckeye, Catalpa, Ironwood, and Amur Corktree should be used as species of choice. Also more Crabapple varieties should be included to add variability and resistance to apple scab.

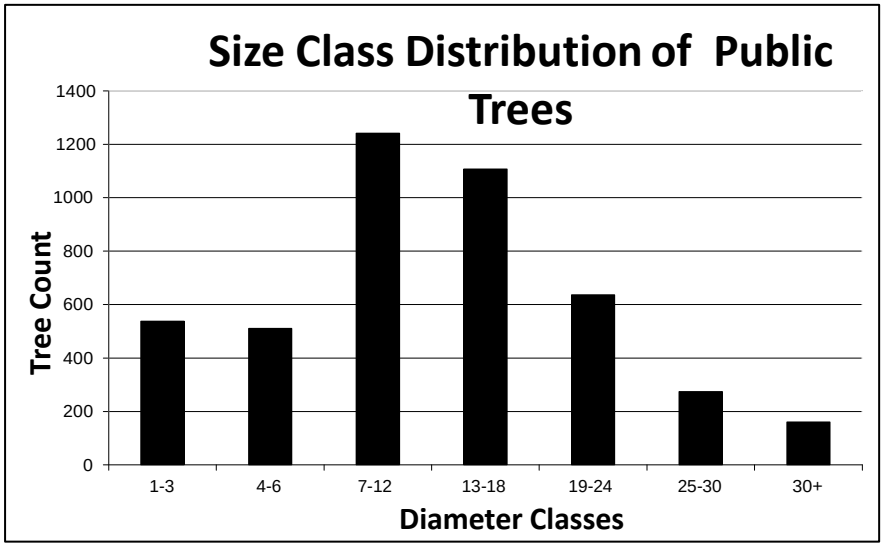
C. Public Tree Size/Condition/Value Discussion

1. Size Class Distribution

The City of Burlington's public tree inventory shows a moderate aged tree population, 52.5% of the trees are in the 7-12" or 13-18" diameter classes. 23.5% of the trees are in the smallest diameter classes (1-3" and 4-6"), while the largest diameter classes make up the remaining 24% of the population. (See **Figure 1**) From the aspect of future maintenance this is good because many of the problems with form and structure can be corrected with regular maintenance while the trees are young or moderately young. This also extends tree life and reduces future maintenance costs. The overall condition of younger trees can be improved for less expense than with larger trees where poor structure and form have gotten to the point that they are no longer correctable. This is also reflected in the fact that *Training Pruning* is the second most recommended maintenance procedure over the next 5 years with **22.6%** of the trees needing it.

The distribution of size classes is close to the desired "bell-shaped" curve with 60 to 70% of the trees falling in the 7-12", 13-18", and 19-24" classes respectively. The 4-6" class should be somewhat higher than the present situation. This will change with time as trees from the 1-3" class move up into this class from additional plantings taking place.

Figure 1



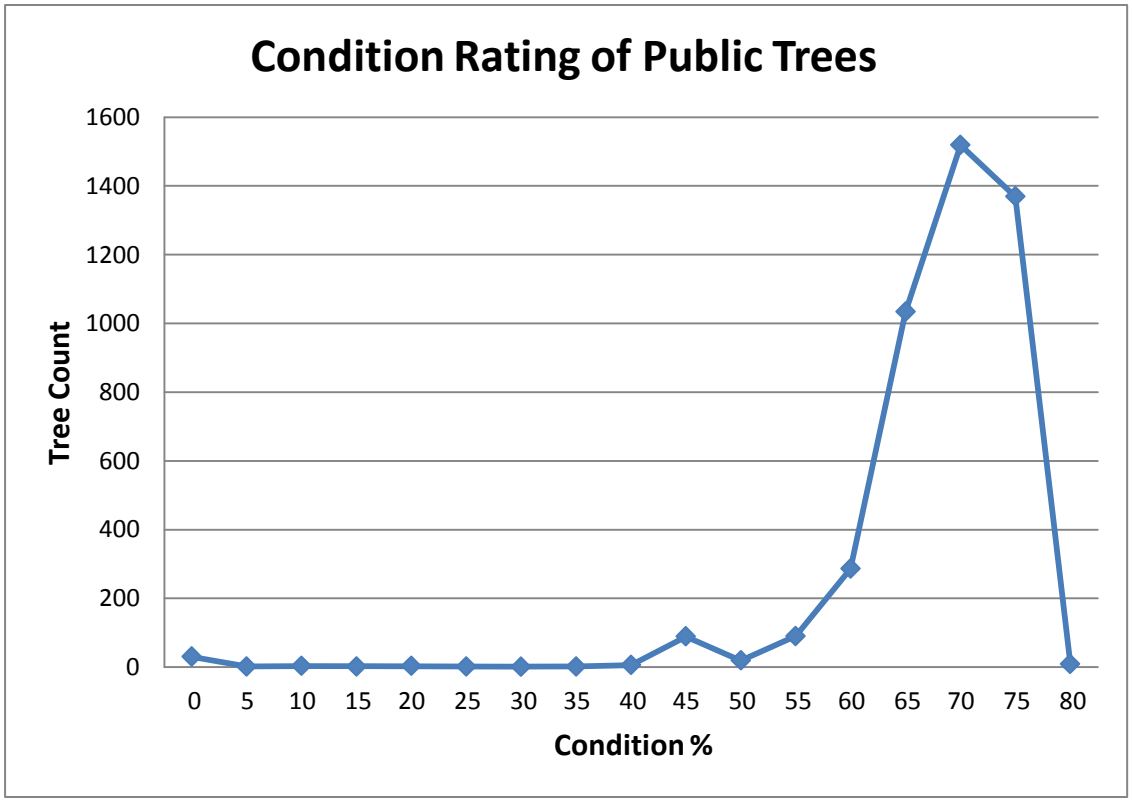
2. Condition Rating

This area looks extremely encouraging and is a credit to maintenance practices the City has implemented.

Of the younger trees (1-12" in diameter) **81**% of the population in these three diameter classes are in one of the top three condition classes (70% or above). Some of the larger diameter trees in this group may not need further training pruning while others that are having difficulty becoming established may need to be removed and replaced.

There is opportunity to improve these condition ratings because younger trees do tend to be more vigorous. They require more frequent pruning visits, once every two to three years versus every five to seven years for *Routine Prune* (trees >8" in diameter). Supplemental watering for at least two years after transplanting is also a critical component of early tree maintenance. It is imperative to keep on top of the pruning and moisture requirements of younger trees so their condition rating improves as they grow in size and they don't become liabilities later in life. The key is to strive to maintain a high condition as the trees become older.

Figure 2



3. Maintenance

In the larger trees (13"+ in diameter) 48% are in a condition class above 70% and 52% are below the 70% condition class. Many of these larger diameter trees that fall in the below 70% condition class are Green Ash and Norway Maple that have co-dominant stems and included bark. The vast majority of these two tree species with these structural issues received a condition class rating of 60 to 65%. (See **Table 1**)

Table 1

PUBLIC TREES PER CONDITION CLASS AND DIAMETER CLASS

CONDITION CLASS %	DIAMETER CLASS (Inches DBH)							TOTAL
	1 - 3	4 - 6	7 - 12	13 – 18	19 -24	25-30	30+	
90 - 100	0	0	0	0	0	0	0	0
80 - 89	4	1	4	0	0	0	0	9
70 - 79	335	369	669	443	186	60	21	2083

CONDITION CLASS %	DIAMETER CLASS (Inches DBH)							TOTAL
	1 - 3	4 - 6	7 - 12	13 – 18	19 -24	25-30	30+	
60 - 69	33	46	194	356	280	131	73	1113
50 - 59	2	1	14	29	19	8	6	79
40 - 49	8	7	18	17	14	6	1	71
30 - 39	1	1	1	0	0	0	0	3
20 - 29	3	0	0	2	0	0	0	5
10 - 19	2	0	1	0	0	0	0	3
0 - 9	23	0	2	0	2	0	0	27
	411	425	903	847	501	205	101	3393

The focus of routine pruning in these larger diameter size classes should be with trees that are currently in the 60 to 70% condition classes. There is a good chance for a number of these trees to move into higher condition classes, if a 5 to 7-year routine pruning schedule can be sustained. Due to the varied tasks required of the employees in the Department and current budget restraints both routine and training pruning activities do not receive the priority level that public trees require. A goal should be set to attain placing at least 85% of the trees into condition classes above 70% within the next 5 to 7 years. Currently 65% of all existing trees have a condition rating of 70% or higher.

Improving the condition of some of the older trees that are less desirable species (Boxelder, Silver Maple, Siberian Elm and Eastern Cottonwood in particular - 218 trees, 13"+ DBH) may not be possible. These four species fortunately only make up a relatively small percentage (4.9%) of the total population. It has to be accepted that these trees will not live as long and the main goal will be to make sure hazards are reduced as much as possible. The City should see a service life of 30 - 40 years from most of these trees, yet it should be 80+ years if they were proper species. Poor species selection not only increases maintenance costs but also requires replanting sooner.

Overall the City of Burlington's urban forest is in fair to good shape. An increased focus on maintenance; primarily training pruning, proper planting techniques and aftercare will help guarantee healthy trees that add value to the community for many generations to come.

Clearance Pruning is also important. There are 50 trees (1.5% of the total) in the terrace tree inventory that are in need of some type of clearance pruning. These 50 trees

comprise: trees having branches interfering with vehicular (6%) and pedestrian (78%) traffic or limbs blocking signs/ lights (16%).

Vehicular and walk clearance account for 84% of the clearance issues. Of the trees that fall in these two groupings, 74% are in the 2" to 12" DBH class. Time should be taken over the next several years to visit these trees and perform "crown raising". With some of larger diameter trees this may require two visits spaced out over a two or three year period so that too much crown is not removed at one time.

For other clearance issues low limbs need to be removed now before they get too large. This prevents a large wound being created at a later time. Trees do not have to be raised evenly; they can be left lower away from the street. Even though the public frequently objects to this pruning appearance, it is important to educate them of the benefits to the health of the tree by leaving as much foliage on the tree as possible, while meeting the necessary street side clearance requirements. The young trees should be raised as they become established to prevent these problems (part of training pruning). Be sure not to elevate too much at one time, or the tree's health can be severely affected. Preventative maintenance is performed on equipment (trucks, etc.) even though they are losing value. What better investment than maintenance on trees which increase in value!

4. Public Tree Value

Table 2 breaks down the value of the trees by species. This *trunk formula method* was developed and approved by the International Society of Arboriculture and Council of Tree and Landscape Appraisers, 7th edition. This is not the newest version, because the newest version does not lend itself to this format (it is more for individual landscape tree use). A figure of $31.00/sq. inch of diameter area (average value of a 3" B&B nursery purchased tree in the Racine/Kenosha metro area) is multiplied by a species (%) value (determined by species rating guides published by various upper Midwestern states), a location value (70% for street trees in primarily residential areas with moderate to heavy stocking) and the condition (%) value determined by field observations and data.

This trunk formula method is limited in assigning proper values to trees in the 1" to 2" DBH ranges due to the low square inch diameter product produced. An example of a 1" DBH tree calculation would be: 1" times 1" equals 1 sq. in. of diameter area, multiplied by $31.00 giving a basic tree value of $31.00 before species, location, and condition deductions are factored in. Whereas a 3" DBH tree 3" times 3" equals 9 sq. in. of diameter area, multiplied by $31.00 gives a basic tree value of $279.00. A 2" DBH tree would have a basic value of $124.00.

Total public tree value for the inventory of the City of Burlington is $5,301,539.95. This equates to an average value of $1,187.09 for each inventoried tree along the City's streets, in parks and other public properties. Given slightly higher condition classes, and 5 to 10 more years of growth to boost diameter and height, then it becomes obvious that the value of the City of Burlington's urban forest would be even higher.

Table 2 City of Burlington Public Tree Valuation Report

Common Name	Species Count	Total Value of Species	Average Species Value
American Basswood	61	$173,994.47	$2,852.37
American Elm	12	$27,031.70	$2,252.64
Amur Maple	10	$2,144.39	$214.44
Apple Spp.	2	$62.70	$31.35
Austrian Pine	24	$20,404.69	$850.20
Bigtooth Aspen	1	$2,007.05	$2,007.05
Baldcypress	1	$321.26	$321.26
Birch Spp.	23	$3,345.48	$145.46
Bitternut Hickory	1	$1,011.55	$1,011.55
Black Cherry	6	$8,503.92	$1,417.32
Black Locust	16	$8,375.82	$523.49
Black Walnut	47	$112,165.35	$2,386.50
Boxelder	40	$11,003.40	$275.08
Bur Oak	63	$396,704.77	$6,296.90
Butternut	1	$348.37	$348.37
Callery Pear Spp.	82	$26,773.57	$326.51
Catalpa Spp.	10	$40,754.29	$4,075.43
Cherry and Plum Spp.	13	$1,969.55	$151.50
Colorado Spruce	63	$47,959.83	$761.27
Cornelian Cherry	1	$22.48	$22.48
Crab Apple Spp.	80	$22,608.95	$282.61
Douglas-Fir	20	$19,097.47	$954.87
Eastern Cottonwood	12	$32,034.03	$2,669.50
Eastern Redbud	16	$1,315.02	$82.19
Eastern Redcedar	14	$10,281.04	$734.36
Eastern White Pine	16	$9,593.36	$599.58
Elm Spp. (Hybrid)	5	$1,033.23	$206.65
European Ash	13	$11,084.03	$852.62
Freeman Maple	172	$40,215.52	$233.81
Ginkgo	5	$4,362.58	$872.52
Green Ash	486	$549,137.03	$1,129.91
Hackberry	101	$223,102.48	$2,208.94
Hawthorn Spp.	10	$1,325.17	$132.52
Honeylocust (Thornless)	343	$439,569.17	$1,281.54
Hornbeam Spp.	7	$839.29	$119.90
Horsechestnut	1	$4.30	$4.30
Ironwood	4	$1,705.19	$426.30
Japanese Tree Lilac	29	$5,530.43	$190.70
Kentucky Coffeetree	7	$3,309.91	$472.84

Common Name	Species Count	Total Value of Species	Average Species Value
Lilac Spp.	1	$46.96	$46.96
Littleleaf Linden	172	$188,383.20	$1,095.25
Maple Spp	8	$47.77	$5.97
Mulberry Spp.	4	$3,672.44	$918.11
Northern Red Oak	18	$21,671.23	$1,203.96
Northern White-Cedar	69	$5,049.05	$73.17
Norway Maple	878	$1,120,156.73	$1,275.80
Norway Maple Var.	232	$261,252.59	$1,126.09
Norway Spruce	29	$49,660.27	$1,712.42
Oak Spp.	1	$5.22	$5.22
Ohio Buckeye	1	$252.89	$252.89
Other, Unknown	4	$75.06	$18.77
Pagoda Dogwood	3	$37.46	$12.49
Paper Birch	1	$619.32	$619.32
Pine Spp.	1	$63.22	$63.22
Quaking Aspen	7	$1,779.65	$254.24
Red Maple	151	$52,781.97	$349.55
Red Pine	12	$7,349.01	$612.42
Redmond Linden	91	$108,895.43	$1,196.65
River Birch	19	$12,184.66	$641.30
Scotch Pine	13	$10,573.53	$813.35
Serviceberry	15	$300.46	$20.03
Shagbark Hickory	20	$44,392.71	$2,219.64
Siberian Elm	58	$28,761.63	$495.89
Silver Maple	264	$351,583.68	$1,331.76
Sugar Maple	165	$276,807.42	$1,677.62
Swamp White Oak	6	$2,924.99	$487.50
Sycamore	1	$624.48	$624.48
Turkish Filbert	1	$89.92	$89.92
White Ash	322	$277,159.78	$860.74
White Oak	32	$176,856.03	$5,526.75
White Poplar	1	$836.08	$836.08
White Spruce	33	$10,254.01	$310.73
Willow	5	$18,056.75	$3,611.35
Yellow Buckeye	5	$1,016.60	$203.32
Yellow-Poplar	4	$5,845.33	$1,461.33
Yellowwood	1	$419.61	$419.61
TOTALS	4466	$5,301,539.95	$1,187.09

III. REVIEW AND CONCLUSION

This GIS tree inventory is a dynamic, powerful management tool. It is imperative that it constantly be updated as work is performed and new trees are planted and others removed. It is recommended that a review and City wide updating of the inventory be performed in **2018**.

With the inventory completed, the collected data will be analyzed and an action plan will be developed. The City will have one of its employees become an International Society of Arboriculture Certified Arborist within the next year. Having a Certified Arborist as well as a Horticulturist on staff will ensure that proper tree care procedures will be part of the City's best management practices.

With an **asset** of **over $5.3 million**, the City of Burlington's public trees deserve the best knowledgeable care the City can provide.

City of Burlington

URBAN FOREST MANAGEMENT PLAN

I. INTRODUCTION

The purpose of this Management Plan is to review the data collected in the street and park/municipal property tree inventories and through analysis, develop management scenarios for both tree populations. From this, build upon or as necessary redirect efforts to maintain in a cost effective manner, a healthy, safe, diverse and growing urban forest.

This management plan will focus on the inventoried public tree population excluding the public ash population. A "5-Year Emerald Ash Borer Implementation Plan" has been prepared for the City as a separate document. That document contains pertinent ash tree data as well as costing over a five year period for implementation of the plan. The previous section of this document includes discussions on all public trees and gives an overview of diameters, condition and species mix for the entire population.

The City of Burlington's community forest (combined street and park/municipal property trees) is in generally good shape. The overall condition is about average for most moderate-sized communities we see. In the 1 - 12" diameter classes 80% of the trees in this group are healthy (70% or greater condition rating). In the diameter classes >12", 46% are healthy. It is important to both maintain and improve upon these condition classes as the trees grow older. Focused maintenance (i.e. training pruning, proper mulching and young tree watering) early in a tree's life will be easier than trying to correct a lot of problems later. As it is, there will be continued work in the future due to changing maintenance needs as the trees grow older. This maintenance is imperative for the quality of life, property values and especially the safety of the City of Burlington's citizens.

To that end, the priorities in the Management plan are:
1.) Removals, including stump removal
2.) Safety and Clearance pruning
3.) Training pruning (23.6% of the combined inventoried trees need this)
4.) Yearly inspections of lower condition class trees with special focus on the "*Consider Removal*" trees
5.) Identify any additional training needs for City crews to acquire proper tree skills (planting, pruning, hazard tree recognition, insect and disease identification, etc.)
6.) Prepare a recommended species list for new tree plantings for the City
    - proper species selection and diversity are key to reduced future costs and a healthy urban forest
    - larger planting sites will help make it easier to grow healthy trees
7.) Regular maintenance pruning is needed to keep trees healthy

Removals, safety and clearance pruning have to be given priority to eliminate hazards. Training pruning performed early in a tree's growth cycle, establishes proper branching structure and reduces long term maintenance costs. Focus must be maintained, so that low priority items that are easy to do, are not moved up. It is imperative to deal with the most important problems first. As these are dealt with, maintenance costs will decrease, safety will be greatly improved and the value of the City of Burlington's urban forest will increase.

II. STATEMENT OF PURPOSE AND SCOPE

A. Purpose

Build upon the foundation of the comprehensive urban forestry street and park/municipal property tree inventory conducted between mid-July and late August 2013 by reprioritizing field operations along with policies and procedures as needed to enhance the management of the urban forest resource.

B. Scope

This plan provides an outline of the community's urban forestry goals. It gives citizens, community decision makers and the staff of the City of Burlington a clear set of strategies to achieve these goals. The goals and strategies, together with the accompanying management plan, propose a timetable of implementation and where possible, provide estimated costs to achieve the goals set forth.

III. MISSION STATEMENT

Where appropriate street terrace widths are present and suitable planting sites exist in parks/municipal properties, create an aesthetic atmosphere in the City through maintaining a diversity of high quality healthy young, intermediate and mature trees. By providing quality tree care on a low cost regular basis, public trees will continue to be a significant asset to the City. Quality care of public trees will also inspire and educate residents to properly care for trees on private property.

IV. GOALS & STRATEGIES

GOAL 1:
Maintain the City of Burlington's urban forest in a cost effective, healthy and safe condition through proper care and maintenance of trees.

Strategies:

- Use the 2013 street and park/municipal property tree inventories and field survey results to establish a maintenance action plan (part of the management plan)
  - Perform comprehensive updated inventory in 2018

- Implement maintenance goals from the management plan
  - Review yearly work plan with the Park Board in the summer of each year prior to budget submission to the Council
- Insure safety with regular inspections of street, park, and municipal property trees
- Promote homeowners to assume a sense of ownership in public trees by encouraging them to perform seasonal maintenance (i.e. mulching and watering)
  - City crews and contractors set an example by doing proper tree care
  - Collect information from (National Arbor Day Foundation, DNR, etc.) to be shared with citizens. Set up public events to distribute information
  - Create tree related articles for City newsletter
- Establish a "best management practices" manual that contains standards and specifications for performing tree work
  - Increase City employee training in proper tree care
  - Hold at least one membership in ISA and WAA and have a person attend WAA meetings
  - Strive to get at least one person on staff to become an ISA Certified Arborist
  - Consider hiring only private contractors that agree to adhere to proper ANSI standards and who employ Certified Arborists
  - Develop and enforce tree protection standards to be part of Public Works and Parks contract specifications
  - Update ordinance to make the standards enforceable
- Educate others of the importance of trees, along with the current condition and goals for City of Burlington' urban forest
  - Make sure the importance of the role other city departments have in maintenance and development of the City's Urban Forest is made clear.
- On a regular basis, update 2013 inventory to insure maintenance records are kept current

GOAL 2:
Establish and maintain maximum tree cover, age and species diversity, with proper site and species selection to minimize hazards and maintenance costs.

Strategies:

- Implement planting goals from the management plan
  - Review and update recommended species list
  - Increase budget dollars for street and park tree planting
  - Increase plantings in areas that were identified in the GIS inventory as currently lacking street trees
- Seek out additional ways to provide funding for planting
  - State grants (DOT and DNR)

- Community groups
- Businesses (homeowner discounts from nurseries where the City is purchasing planting stock)
- Strengthen Developers agreements to reflect the City's management plan where they are utilized

GOAL 3:
To have an educated public that knows what proper tree care is.

Strategies:

- Promote public awareness through publications and appearances at civic groups and schools
- City Council sign an annual Arbor Day proclamation and host an Arbor Day program, presentation or award
- Communicate the importance of tree care to City departments, construction contractors and residents
- Maintain Tree City U. S. A. status

V. CURRENT SITUATION

A. Ordinances

Current ordinance language with respect to care and protection of public trees is lacking comprehensiveness and is currently scattered throughout various chapters. See below:

227-5 PUBLIC NUISANCES AFFECTING PEACE AND SAFETY
This chapter speaks to obstruction of intersections; tree clearance over streets and walks; and "Dangerous Trees" – "All trees which are a menace to public safety or are the cause of substantial annoyance to the general public."

227-7, 8 and 12 ABATMENT OF NUISANCE, COST, VIOLATIONS AND PENALTIES
Procedures for resolution once a tree is declared a nuisance.

234-4 PLANTING AND REMOVAL OF TREES OR SHRUBS
Requires a permit for planting or removing a tree on any public property. Gives the Park Board the authority to publish rules and regulations for the planting and removal of public trees. Spells out penalties for non-compliance.

278-65 and 82 STREET TREES AND TREE FEE
In subdivisions and minor land divisions, the developer is required to plant at least one tree for every 50 feet of frontage on proposed dedicated streets. A fee is collected if the subdivider does not plant street trees.

278-72 EXISTING FLORA

Requesting the subdivider to protect existing vegetation as much as possible during construction.

315-52 LANDSCAPING

This chapter is found in the zoning code and speaks to various landscaping requirements for new development where buffer yards are required. It is fairly complete in detail. **315-48** explains requirements for minimum required size of plants. **315-138** lays out the requirements that must be contained in the submitted landscape plan.

Ordinance Recommendations

- It is recommended that a public tree ordinance be drafted that is comprehensive and primarily covers the planting and removal of trees within public rights-of-way. It should also contain provisions governing maintenance or removal of private trees which pose a hazard to the traveling public. Once a tree ordinance is enacted, many of the existing sections can be repealed. Below is a sample table of contents.

  CHAPTER XX –URBAN FORESTRY
  XX.20 Purpose and Intent
  XX.21 Definitions
  XX.22 Tree Advisory Board XX.23
  Nuisance Trees Prohibited XX.24
  Standards and Specifications
  XX.25 Public Nuisances, Declaration and Abatement
  XX.26 Planting, Maintenance and Removal of Public Trees and Shrubs
  XX.27 Tree Protection During Construction
  XX.28 Private Tree Maintenance
  XX.29 Penalty
  XX.30 Appeals

This chapter would be the overarching section in the Burlington Municipal Code that establishes policies, regulations and standards necessary to insure that the community will continue to realize the benefits provided by its urban forest.

- The subdivision Chapter 278 and zoning Chapter 315 as their reference to trees should be retained as is currently in place.

- Include in the nuisance section, provisions for oak wilt (Ceratocystis fagacearum), Asian Longhorned beetle (Anoplophora glabripennis) and Emerald ash borer (Agrilus planipennis).

- Creation of a Public Tree Care Manual. A good example for the Village of Howard (Arboricultural Specifications Manual) can be found at the following website:
  http://www.villageofhoward.com/cm/pdfs/recreation/Arb%20Specs%202011.pdf

- **Appendix H** is intended to provide resource information regarding sample Tree Protection Provisions.

SPECIAL NOTE:
Inserting large amounts of detailed arboricultural information in an ordinance makes it cumbersome and difficult to change. One of the advantages of having management standards and specifications separate from the ordinance is the ease of making changes. A change made by the Park Board is done more quickly than changing the Municipal Code through City Council. Another advantage to separate standards and specifications is that exceptions can be authorized by the Park Board whereas ordinances are considered municipal law. Greater detail can be written into standards and specifications when they are separate from municipal code.

Through these processes, the City of Burlington's trees will receive the protection and consideration they warrant.

B. Tree Administration

The responsibility for all public trees lies with the Burlington Park Board and is delegated to the Department of Public Works Supervisor. This management plan should help establish priorities and commitment in the City system for nurturing the public tree population. A few problems need to be dealt with now, but in the long term, training and maintenance pruning along with new tree planting are the main priorities for future safety, health and benefits of the urban forest. Time needs to be set aside and taken for maintenance of street and park/public property trees.

It is important to have a "go to" person for forestry issues. The public, elected officials, other City staff and state staff need to know who the primary contact is. Also, this person would be the focus of training and support and reduce having multiple people answer questions differently and leading to conflict (i.e.. one person asks a parks staffer about pruning along a drive, then asks a public works employee - you can get opposing answers). It can also help in pulling workload from staff (for calls, emergencies, staff questions, etc.) that are not trained or equipped to deal with tree issues.

It is encouraging to see that the administration realizes the role that trees play in the City's infrastructure. Having this support is vital in giving consistency and focus to the field work that is required in maintaining a safe and healthy public tree population. It will be critically important to have the financial and administrative support of the City Administrator and the Common Council to help in moving the urban forestry program forward with an overall focus on the goals and objectives.

By and large, the Department seems to be somewhat understaffed for managing the current tree population. If new tree planting continues to expand and as the existing population matures, additional staff or more outside contracting will be needed to meet the demand. Current arboricultural skill levels are fair to good within the staff. Management encourages and provides time for staff training to keep employees current with the latest techniques and procedures. Tree biology, training pruning practices, chain saw safety and felling techniques are training modules are scheduled with staff during December 2013.

In 2011 the Department spent approximately $37,100 on trimming and removal activities. That number increased to $59,800 in 2012. An average of 25 trees per year have been planted over the last decade. No data was provided for contracting, equipment rental and supplies. The average hourly rate (incl. fringe benefits) for employees performing tree work is $30.15 per hour. With the current City budget being fairly restrictive towards an increase in forestry activities at this time, the $59,800 figure will be used as the starting point for the "Estimated Costs for a Five Year Urban Forest Implementation Schedule". The schedule **(Table 3)** can be found later in this document.

Currently the Department owns the following equipment that is appropriate for forestry activities: bucket truck, brush chipper, chip truck, ten chain saws, and hand pruning equipment.

The Department might want to consider renting a stump grinder once or twice per year. Not only could this unit be used for grinding stumps that are generated from tree removal operations, but it is an excellent piece of equipment to dig planting holes for new tree planting. A soil auger has the potential to glaze the sides of the planting hole, making it difficult for new tree roots to penetrate into undisturbed soil areas beyond the planting hole. This increases the establishment period for newly planted tree.

By utilizing the evolving GIS tree inventory, the Department should attempt to establish a rotational pruning cycle within the City. The goal would be to set up a tree pruning cycle based on a 5 year rotation.

It is important that the work strategies are well thought-out so that they can fit correctly into the existing system of overall departmental responsibilities. It is good to see that part time help is hired annually to handle some of the operations (like mowing, mulching and watering) to free up crew hours for tree work. A critical factor is to stay current with arboricultural practices. Opportunities for appropriate training for the staff are a priority of management. It is easier to train someone to run a lawn mower than it is to train a person to perform proper pruning. Improper pruning can have long term negative impacts on tree health and City budgets.

One goal that should be relatively easy to attain within the next year or two is the creation of a procedures manual for forestry activities. A sample manual prepared by the Village of Howard can be found at the link:
http://www.villageofhoward.com/cm/pdfs/recreation/Arb%20Specs%202011.pdf

Also consider, *Best Management Practices for Tree Care Operations* published by the International Society of Arboriculture and various *ANSI Standards for Tree Care Operations* published by the American National Standards Institute. These are excellent supplements to include in a procedures manual.

An area that is not seen as a problem is wood residue utilization. Currently brush/wood chips generated by City crews are utilized as mulch for either street trees or park tree and shrub plantings, plus base for walking trails. Excess chips are provided to City residents.

C. Inventory Summary – All Public Trees (Non-Ash)

While the distribution of age and size classes is not ideal, it is fairly typical of smaller sized communities having a minimal growth phase in new housing stock in the last decade. Also, until recently, there has not been a strong commitment towards maintaining the public tree population. This is confirmed by the lower condition rating of many of the larger diameter trees.

A moderate number (37%) of trees fall into the lower condition classes, below 70%. Most of these lower rated trees fall in the 60 to 69% condition class and are heaviest in the larger diameter classes (13"+). This indicates that overall the City's public trees are in fair condition. Current maintenance practices have not been keeping up with most of the pruning needs of this medium aged urban forest.

The most immediate work that needs to be performed includes: tree removals (117), safety pruning (433) which is primarily deadwood, and crown raising for clearance (35). By focusing on these areas of work first, the City will be using the most cost effective approach. Training pruning (836) young trees (1 - 8" diameter) and routine pruning (1,918) should be able to establish a five to seven year rotational pruning program. Also, a yearly street tree planting program should target planting at least 25 trees per year. This will ensure new trees are being planted to expand the street tree population in selected areas and to replace those that are lost. Establishing a species list and planting plan and planting policy will also help to save a lot of mistakes by getting better species planted. More species diversity is strongly encouraged.

Currently the genera *Acer* (Maples and Boxelder) and *Tilia* (Basswoods and Lindens) make up 72% of the non-ash street tree population. This is beyond the acceptable range. It is important to reduce this percentage over time by making sure no additional plantings or at the very most, limited plantings from these groupings occur. Better species selection has been implemented and needs to continue.

Non-ash species diversity is also poor within the park/municipal property sites. *Acer* (Maples and Boxelder) account for 24% of the species mix. *Picea* (Spruces), *Pinus* (Pines), *Quercus* (Oaks), *Thuja* (Arborvitae) and *Tilia* (Basswoods and Lindens) add another 40% to the total. The number of undesirable species is limited, which is encouraging to see.

Plant species that are not currently represented in the inventory but have unique attributes and necessary hardiness. Some possible suggestions could include: Swamp White x Bur Oak hybrid, several varieties of disease resistant Elm hybrids, Bitternut Hickory, Ohio Buckeye, Baldcypress, Ironwood, Amur Corktree, and Serbian Spruce. Parks and other public open spaces are wonderful areas where new introductions of trees can be planted and observed for several years to make sure their growth and feature characteristics meet the criteria for possible future street tree plantings.

VI. REVIEW OF RESOURCE & DISCUSSION

A. Introduction

Priorities in the Goals section for the public trees were set with safety being the most important criteria. Therefore, the first items dealt with were removals (incl. stumps), clearance pruning (for streets) and safety pruning. Included early on were the beginning of a training pruning program, starting a routine pruning program on a limited basis, watering newly planted trees and addressing the priority bolt and prune trees. The street tree planting program should continue in 2014 and beyond. It is also recommended that an expanded park tree planting program be initiated in 2014 addressing species diversity. Training pruning needs to be ramped up in 2015 as an important means of directing future growth and reducing costs for the City's urban forest. After these programs are up and running, the focus can be spread out to include more routine pruning.

It is important to stay focused on the priorities given the limited funding for tree maintenance activities. **Table 3**, "Estimated Costs for a Five Year Urban Forest Implementation Schedule" summarizes the expenses by area and function per year. This table was compiled using the priorities from the Goals section and data from all the trees included in the inventory. As problems are corrected, there may be a reduction in cost over time. The yearly budgets are only suggestions and depend on overall funding levels available.

B. Estimated Costs

All projected costs in **Table 3** are made with the assumptions that work will be performed by City crews with an average cost of $30.15 per hour (including payroll taxes and benefits) for full-time staff and $10.50 per hour for seasonal personnel. Some of the larger pruning, tree and stump removals, may need to be performed by tree contractors with more specialized skills and equipment. It is estimated that contractor costs ($85.00 per hour estimate) will be approximately 3 times higher than the hourly rate used in the illustrations. Actual costs could vary and no factor for inflation has been included.

Estimated Costs for a Five Year Urban Forest Implementation Schedule

(Table 3) Public Trees (Non-Ash) –In House

Estimated costs for each activity			**2014**		**2015**		**2016**		**2017**		**2018**		**Five Year Cost**
Activity	Diameter Class	Cost/Tree ($)	# of trees	Total Cost	# of trees	Total Cost	# of trees	Total Cost	# of trees	Total Cost	# of trees	Total Cost	
TREE REMOVALS	1-5"	33.00	40	1320.00									
	6-10"	63.00	13	819.00									
	11-15"	120.00	28	3360.00									
	16-20"	215.00	19	4085.00									
	21"+	375.00	17	6375.00									
Activity Totals			**117**	**15959.00**	**(M)**	**3000.00**	**(M)**	**3000.00**	**(M)**	**3000.00**	**(M)**	**3000.00**	**27959.00**
PRIORITY PRUNING (SAFETY, CLEARANCE, DEADWOOD)	1-5"	12.50	4	50.00	4	50.00							
	6-10"	39.00	14	546.00	14	546.00							
	11-15"	63.00	49	3087.00	48	3024.00							
	16-20"	96.00	59	5664.00	59	5664.00							
	21"+	135.00	109	14715.00	108	14580.00							
Activity Totals			**235**	**24062.00**	**233**	**23864.00**	**(M)**	**2500.00**	**(M)**	**2500.00**	**(M)**	**2500.00**	**55426.00**
TRAINING PRUNING	1-5"	21.00	50	1050.00	270	5670.00	320	6720.00	280	5880.00	280	5880.00	
	6-10"	45.00	38	1710.00	60	2700.00	98	4410.00	70	3150.00	70	3150.00	
	11-15"	78.00											
Activity Totals			**88**	**2760.00**	**330**	**8370.00**	**418**	**11130.00**	**350**	**9030.00**	**350**	**9030.00**	**40320.00**
ROUTINE PRUNING (MAINTENANCE)	6-10"	57.00	20	1140.00	60	3420.00	80	4560.00	90	5130.00	81	4617.00	
	11-15"	93.00	10	930.00	110	10230.00	160	14880.00	170	15810.00	176	16368.00	
	16-20"	145.00	5	725.00	55	7975.00	125	18125.00	145	21025.00	144	20880.00	
	21"+	205.00	5	1025.00	45	9225.00	105	21525.00	135	27675.00	197	40385.00	
Activity Totals			**40**	**3820.00**	**270**	**30850.00**	**470**	**59090.00**	**540**	**69640.00**	**598**	**82250.00**	**245650.00**
TREE PLANTING	Site Prep	16.00	25	400.00	25	400.00	25	400.00	25	400.00	25	400.00	
	Tree Cost	130.00	25	3250.00	25	3250.00	25	3250.00	25	3250.00	25	3250.00	
	Planting	55.00	25	1375.00	25	1375.00	25	1375.00	25	1375.00	25	1375.00	
Activity Totals			**25**	**5025.00**	**25**	**5025.00**	**25**	**5025.00**	**25**	**5025.00**	**25**	**5025.00**	**25125.00**
OTHER MAINTENANCE	Stake Removal	8.00	16	128.00	25	200.00	25	200.00	25	200.00	25	200.00	
	Watering (3x)	21.50	50	1075.00	50	1075.00	50	1075.00	50	1075.00	50	1075.00	
	Mulching	11.00	25	275.00	25	275.00	25	275.00	25	275.00	25	275.00	
	Watch	8.00									280	2240.00	

	Stump Removal	4.00/inch	1495 "	5980.00	(M)	1000.00	(M)	1000.00	(M)	1000.00	(M)	1000.00	
	Cable&Prune	170.00	4	680.00	5	850.00	(M)	300.00	(M)	300.00	(M)	300.00	
	Girdling Root	140.00	(M)	400.00	(M)	400.00	(M)	400.00	(M)	400.00	(M)	400.00	
				8538.00		**3800.00**		**3250.00**		**3250.00**		**5490.00**	**24328.00**
Totals per Year				**60164.00**		**74909.00**		**83995.00**		**92445.00**		**107295.00**	**418808.00**
	(M) = REGULAR MAINTENANCE ITEM REOCCURRING YEARLY OR ON A CYCLE												

C. Summary

The data projected in **Table 3** was extrapolated directly from the database created from the public tree inventory that was conducted during the summer of 2013. It provides a starting point for City staff to see what the current needs are with respect to the public tree population. Obviously staff will have to make some priority choices in order to keep cost within each annual budget allocation.

Overall costs projections for the first five year period of the Implementation Schedule for all public trees averages about $83,760 per year over the projected five years. Based on the 2012 budget of $59,800 for trimming and removal activities, there would be a $364 budget shortfall in 2013. This will progressively become much greater over the succeeding four years. With an average annual projected cost of $83,760 for the five year period, it is apparent that instituting a more aggressive public tree program will have a substantial impact on the current funding level. This is further exacerbated by the financial strain that Emerald Ash Borer management will be putting on the City. It is strongly recommended that the City of Burlington also strive to implement additional street tree plantings to infuse more species diversity into the population and lessen the impact of the Emerald Ash Borer infestation. There are around 400 identified vacant planting sites along the streets where species diversity planting can take place.

Supplementary funding might be secured through additional Urban Forestry Assistance Grants for implementation of this management plan. There are also other possible funding sources through, fund-raising events in conjunction with the business community or possibly homeowners paying for the wholesale cost of the tree and the City paying for the planting labor.

Realize that the costs in the Implementation Schedule are only projections. As stated before, removals and safety issues are of first priority. Years 3, 4 and 5 are when most routine pruning would expand in activity level.

D. Implementation Detail

Tree and Stump Removal (see **Table 3**)

The first year of budgeting will take care of the tree removals that were determined from the inventory (total of 117 trees, $21,939.00). After 2014 this activity becomes a regular maintenance item with $3,000.00 budgeted annually for tree removal and $1,000.00 for stump removal. Since some time has evolved from when the inventory was concluded to when this management plan is completed, several of the trees in this category may have already been removed.

Safety and Clearance Pruning (see **Table 3**)

Safety Pruning (deadwood, broken limbs hanging in trees and clearance issues) involves 235 trees in 2014 and 233 trees in 2015. After work on these trees is completed, $2,500.00 is budgeted every year as a regular maintenance item. Having the trees on a *Routine Pruning* cycle of every five to seven years will prevent most of the problems that are now being corrected in the *Safety* category.

Of the 468 trees designated as needing *Safety Pruning*, 35 are in need some form of clearance pruning. When raising trees, they do not have to be raised evenly. The street side can be raised to allow for truck clearance and the walk side can be left lower to keep more crown surface.

Training Pruning (see **Table 3**)

The corrective *Training Pruning* is spread out over the first three years. Beginning in 2017 and continuing into 2018 there will be fewer trees needing training pruning. Some trees because of diameter increase will move into the routine prune category, while others because of their species or habit of growth may be able to be skipped for a rotation. This category involves 836 trees, all in the 1 - 8 inch diameter categories. It holds the second largest number of trees of any of the maintenance categories. As new trees are planted, they will need to be added to the *Training Pruning* rotation.

Young trees should be pruned every two to three years for the first 10 years of the establishment period. This is very critical for maintaining street and sidewalk clearances. At the same time, a young tree cannot be raised up (removing lower limbs) too fast or it will not have enough crown area (leaf surface) and will become susceptible to other stresses.

Even more important than clearance pruning, training pruning creates proper structure in the trees. This not only makes the trees safer, but will also greatly reduce future pruning expenses. The amount of time and money it takes to remove a one inch branch with a hand pruner in year five as opposed to using a chain saw at age 30 is obvious. This can greatly reduce future pruning expense and reduce tree decay along with stress.

Routine Tree Pruning (see **Table 3**)

This is regular maintenance pruning for all trees (including mature tree pruning). It is crown cleaning pruning that includes training and clearance pruning as needed. As the trees grow older, this category will become more important. There are only (40) trees in 2014 that require *Routine Pruning*.

As the priority problems are taken care of (by the end of 2014), more money is then budgeted to this category. All trees should be on a five to seven year pruning cycle to keep the trees at maximum health and to prevent most problems from developing. The number of trees requiring *Routine Pruning* increases beginning in 2016. In 15 years the number of trees requiring routine pruning could double and will increase even more over time as the trees mature.

Once the problems are corrected, not budgeting to this area may save money for a year or two. However, problems will reappear needing more money to correct and compromising the safety of citizens. The most cost effective and safe way to manage trees is with *routine* maintenance pruning. You don't wait for trucks to breakdown before changing the oil because usually it is too late by then! The same applies to trees; maintenance prevents problems, extends life and reduces costs.

Tree Planting (see **Table 3**)

An annual planting program should be continued in 2014 with the planting of a minimum (25) 2.0" caliper balled and burlapped trees. This number should be maintained at this level or

greater based on the number of vacant terrace planting sites (398) being available. These sites have been identified in the street tree inventory. Using the visual mapping information in GIS, management can readily discern where the greatest need for future plantings should take place. It is important to continue introducing new tree species into the street tree population to keep and improve the diversity of the population.

If the City uses outside contractors for planting, a primary focus should be to establish planting and aftercare specifications (see **Appendix H -** Tree Planting Standards, p. 3-5) that will be adhered to by all private contractors planting in the public right-of-way. Inspection and enforcement of the specifications is critical at planting time.

When possible, where the terrace is particularly wide, trees should be planted in the back portion of the right-of-way away from the street. Unless they are small scale trees, they should be at an approximate 45' to 50' spacing. This gives enough room for the mature crown to grow (reducing pruning) and can lessen the potential spread of a future pathogen through root grafts. Also, in many areas a larger vision corner should be left by staying farther away from the corner with plantings.

It is recommended that a community wide planting plan be developed after the majority of the existing tree problems are corrected (2015 or 2016). Don't use conifers for street side planting, scale way back or eliminate *Acer* (Maple genus), scale back *Tilia* (Basswood/Linden genus), eliminate *Fraxinus* (Ash genus) for the time being and continue to add more variety in species planted. There are many options to help fund planting; from involving community groups, grants for planting, partnerships with businesses, projects tied to highway work, etc. One successful funding program that has worked well in other communities is a homeowner's request planting program, where the homeowner pays the City for a portion of the cost of planting a tree in the terrace in front of their property.

The planting that does take place should only be trees from the list of Recommended Species (**Appendix C**). This is set up to ensure that the proper size tree is used under utility wires or in a narrower tree terrace situation.

Better quality (single leader) planting stock should be specified and required when ordering nursery stock. During the inventory data collection process, numerous younger trees were observed that had poor structure, primarily double leaders with included bark. It was obvious that this was a problem at the nursery that was not corrected before trees were prepared for sale. The City should expect to receive quality nursery stock from its suppliers that do not exhibit poor structural problems. By using quality nursery stock, the City will be able to reduce the amount of training pruning time spent correcting problems created in the nursery. This is best accomplished by purchasing plant material from nursery firms that are members of the Wisconsin Nursery Association (WNA).

Tree Stake Removal (see **Table 3**)

The inventory detected (16) sites where tree stakes were still in place supporting younger trees. These stakes should be removed in 2014. This is important to prevent potential damage to the trunks of these trees. The year stakes are to be removed is identified in the inventory database.

If the stakes are left on too long and are extremely taut, there is a risk of girdling taking place and causing restriction of water and nutrient flow between the roots and crown, potentially leading to dieback in the crown.

Tree stakes should not be left on for more than two growing seasons. Beginning in 2015, hours are budgeted to remove stakes systematically from trees that were planted two years previous.

Young Tree Watering (see **Table 3**)

A most critical phase of new tree establishment is young tree watering. Through public awareness and education most newly planted street trees can be watered by the adjoining property owner. This saves the City substantial man-hours that can be redirected towards other tree maintenance activities including new park/public property tree watering. Supplemental watering of newly planted trees during the first two to three years after planting is crucial to their survival, becoming established and beginning vigorous growth. This initial care sets the course for getting trees off on the right foot and reduces their chances of succumbing to insects, diseases or environmental stresses in the future. Minimal dollars have been budgeted to provide three visits to visibly stressed trees during the course of a summer.

It is important to realize that more plants are lost to over-watering in our heavy clay soils than to under watering. Roots need air just as much as they need water. Always check the moisture level under the mulch before watering.

Mulching (see **Table 3**)

Creating mulched beds around street trees is important to reduce damage to the base of the trees from mowing and string trimmer equipment. It also creates a superior rooting area for improved tree vigor and better aesthetics. When trees are being mulched, care should be taken to avoid piling mulch against the trunk (see **Appendix H**, mulching for planting). This work needs to be ongoing project of the department. Maintenance funds need to be budgeted every year beginning in 2014 to maintain the mulch at a two to three inch thickness. This mulch can be wood chips from City tree care operations (free) or shredded hardwood mulch (will stay in place better, last longer and look nicer, but must be purchased).

Educating homeowners on the importance of installing mulch rings is vital. Numerous instances were observed when conducting the street tree portion of the inventory field work where basal damage had occurred as the result of mower or string trimmer damage.

Watch (see **Table 3**)

There is also a projected budget amount that includes *Watch* trees as identified in the inventory. These trees should be inspected in 2018 (280 trees); they are all conifers. They rarely require any maintenance; however, they need to be checked periodically for sight clearance issues where they are planted in the street terrace and general overall health and vigor.

Cable and Prune (see **Table 3**)

A total of 9 trees were identified as needing cable and pruning. These trees are budgeted for work being performed in 2014 and 2015. This category will need regular funding beginning in 2016, with $400.00 being budgeted every year to stay ahead of future problems. There are 1,030

public (non-Ash) trees ranging from 3" to 60" dbh that under *Special Conditions* have codominant trunk/stems and/or included bark. These trees are potential candidates for future cabling and the larger diameter trees should be inspected periodically for structural safety issues. Training pruning on the smaller diameter trees should alleviate many of the codominant issues with these younger trees.

Girdling Roots (see **Table 3**)

At present, there were no identified trees with girdling roots. Maintenance dollars of $400.00 are budgeted beginning in 2014 to correct the problem if any are encountered. Girdling root is a situation where a root(s) grows around the base of the tree cutting off the flow of materials through the cambium up into the tree. This will slowly kill the tree over several years. It is a very common problem with Norway Maples and the reason why planting Norway Maples is discouraged. Given that there are 1,110 Norway Maples (30.5% of the non-Ash population) this may become a problem over time. Instead of the trees living 80+ years, they may only live 30 - 40 years. This will increase removal and planting budgets. With the use of an air spade, roots in the root crown area are exposed and the problem roots can be cut away to correct the problem. However, it is not possible to see all problem roots because they are below the surface. Better species selection for new plantings is the long term answer. As the existing Norway Maple population matures, beginning in 2014 and every year thereafter, $400.00 is budgeted for inspection and removal of identified girdling roots.

E. Disease & Insect Problems

Dutch Elm Disease

There are (12) American Elms in the entire inventory for the City. These trees range in size from 10" to 51" dbh. Fortunately this is a small percentage of the overall public tree population. Regular inspections and removal of infected elm trees should be programmed into the maintenance schedule to help break the disease cycle and to keep dead or dying trees from endangering the public.

Six American Elms are at the following street locations: 356 Lewis, 32" dbh; 325 Chestnut, 24" dbh; 340, Kendal 51" dbh; 249 Conkey, 29" dbh; 301 Milwaukee, 31" dbh, and 616 Maryland, 10" dbh. The other six trees are in parks; four at Grove Street Park and one each at St. Mary's Park and Riverfront Park. These trees should be given serious consideration as candidates for macro-injection of Arbotect fungicide. These trees at time of the inventory were healthy specimens and are candidates for fungicide protection. The injection process will aid in protecting trees for 2+ growing seasons from infections of the fungus by bark beetles. Another round of injections would be required after two growing seasons. This work should be done by an arborist firm experienced with this type of procedure.

The City has been planting several varieties of disease resistant hybrid elms. This is a great way to keep the *Ulmus* genus part of the species diversity mix.

Oak Wilt

There was no active oak wilt detected in either the street or park/municipal property inventoried areas. Oak wilt is a fungal disease that invades the water conducting vessels of the sapwood and causes blockage of these vessels. This disrupts sap flow, causing leaves to wilt and eventual death of the tree. The Red Oak group is more susceptible to the disease than White, Swamp White or Bur Oak. The breakdown of oak species inventoried includes: (67) Red Oak, (3) White Oak, (36) Bur Oak, (40) Pin Oak and (176) Swamp White Oak. The Oak family accounts for 8.8% of all the public trees that were inventoried in the City. This total is approaching the threshold of 10% for any one genus in the overall public tree population. Because of this high genus percentage and the potential for oak wilt, limited planting of trees in the *Quercus* genus should be considered for future plantings.

Proper understanding of oak wilt management is critical to properly managing this disease. An excellent publication giving an overview of this disease and its management has been produced by the University of Wisconsin-Extension titled "*Oak Wilt Management – What are the Options*" (publication #G3590).

Gypsy Moth

Since the establishment of gypsy moth in Wisconsin in the 1990s, eastern Wisconsin has had two gypsy moth outbreaks – between 2001-04 and 2008-10. Aerial spraying for gypsy moth in the Burlington area (defined as western Racine County, eastern Walworth County and western Kenosha County) has only occurred at the peak of both outbreaks – 2004 and 2009. In other years, populations were lower and no areas qualified for aerial spraying, or there was no interest in aerial spraying. No visible defoliation has been recorded in the Burlington area during aerial surveys conducted since 2002. There has been no DNR-organized aerial spraying in the City of Burlington since the DNR gypsy moth suppression program began in 2000, although spraying was conducted at Rockland Lake in the Town of Burlington in 2009.

2009: 20 acres treated in the Town of Burlington, Racine County, at Rockland Lake just east of the City of Burlington. 263 acres treated in eastern Walworth County (Big Foot Beach State Park, Town of East Troy and village of Genoa City. 71 acres were sprayed in western Kenosha County, in Twin Lakes and the Town of Wheatland.

2004: 95 acres treated in western Racine County (towns of Rochester and Norway). 224 acres treated in western Kenosha County (Town of Randall and Village of Twin Lakes). No spraying in Walworth County.

Since 2010, gypsy moth populations in the Burlington area have been low, and there have been few reports of nuisance caterpillars. As of November 2013, populations are expected to remain low for the next few years.

Emerald Ash Borer

An Emerald Ash Borer Plan Update was prepared for the City by Wachtel Tree Science in October 2013. This document provides a detailed work plan for City staff to follow as they manage their ash tree population with regards to EAB.

The Emerald Ash Borer (EAB) is an exotic woodborer that was found attacking and killing ash trees in Michigan during 2002. Since its detection, EAB has killed millions of ash trees and is now found in Colorado, Connecticut, Georgia, Illinois, Indiana, Iowa, Kansas, Kentucky, Maryland, Massachusetts, Michigan, Minnesota, Missouri, New Hampshire, New York, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, West Virginia, Wisconsin and Quebec and Ontario Canada. EAB is easily spread through the movement of firewood, logs and nursery stock and is why people have been the greatest cause for the rapid spread of EAB over the past decade.

EAB is a very destructive pest. This insect attacks and kills white, green, black and all horticultural varieties of ash. This insect attacks not only stressed ash trees but healthy and vigorous ash trees as well. The larvae of this insect feed under the bark undetected, disrupting the flow of nutrients and water between the roots and crown of ash trees. The first visible signs are usually crown dieback. By this time it is usually too late to save trees.

Because EAB has now been found in Burlington and the high potential for EAB to become established here, it is recommended that the City place a minimum 5-year moratorium on the planting of new ash trees until the full ramifications of this insect are known.

It is unlikely that there is a one-size-fits-all strategy for managing an infestation of EAB. The best response to an infestation must take into account the unique circumstances surrounding the infestation. Management recommendations involve a number of control options including:

- Mechanical controls, such as removing symptomatic or asymptomatic trees
- Chemical controls, such as using pesticides in specific circumstances
- Biological controls, such as using parasitoids or other natural enemies
- Silvicultural controls, such as reducing the number of target trees and replanting diverse, non-target trees
- Regulatory and Behavioral controls, such as enacting quarantines and enforcing regulations regarding firewood movement

An excellent resource management tool for estimating the economic impact that EAB will have on public Ash populations is the "**Emerald Ash Borer Cost Calculator**". It was developed by Extension Entomology at Purdue University. The software is free to use and can be accessed at: http://extension.entm.purdue.edu/treecomputer/inc

What follows is an overview of what the cost calculator can provide in helping tree managers determine the best option/options for managing EAB in their particular community.

Forest managers have 3 options available for managing emerald ash borer:

- Treat ash trees with insecticides
- Remove ash trees
- Remove ash trees and replace them with resistant trees

The particular combination of these options that is best for any forest depends on the number and size of your ash trees as well as the size of your management budget.

Use this calculator to:

- Compare the annual and cumulative costs over a 25 year period for ANY management strategy that includes a mixture of tree removal, replacement, and insecticide treatment.
- Compare size of the forest remaining over a 25 year period for ANY management strategy that includes a mixture of tree removal, replacement, and insecticide treatment.
- Generate printed reports of projected costs of up to 3 management strategies at a time.

To run the calculator you will need:

- An inventory of the number and size of ash trees
- An estimate of costs for removing and treating trees based on the size of each tree.
- An estimate of costs for replacing each ash tree that is removed.

Additionally, listed below are three websites with current information on EAB:

1. http://emeraldashborer.wi.gov/
    a. EAB internet portal for Wisconsin sponsored by Wisconsin Department of Agriculture, Trade and Consumer Protection, the Wisconsin Department of Natural Resources and the University of Wisconsin – Madison
    b. Contains information from a Wisconsin perspective on EAB biology, management, survey activities, publications and provides related links

2. http://www.emeraldashborer.info/
    a. Official emerald ash borer web page administered by Michigan State University
    b. Contains information on EAB biology, distribution, control measures, current research and links to various EAB infested state's web sites

3. http://dnr.wi.gov/topic/UrbanForests/EABToolBox.html
    a. Wisconsin DNR EAB Toolbox for Wisconsin Communities
    b. Designed for the planning and response needs of municipal governments, including such topics as: "Is Your Community Ready for EAB (video), "EAB: The Opportunity of a Lifetime", "Readiness Checklist", "What Will Happen if EAB is Found in Your Community?" and "EAB University"

Other Pest Problems (by species):

Honeylocust: - leafhoppers and plant bugs (leaf sucking insects that defoliates the tree)

- Relatively easy to control, but the public is often not comfortable with spraying. Can be controlled with a soil injected material for individual high value trees (like park trees or business district area).

- Nectria canker

- A fungus that causes a dead area in the bark, usually at a branch crotch area. Important to keep the tree growing vigorously and out of drought stress. Proper pruning cuts and dormant pruning during dry, lower humidity conditions are important.

Linden: - boring insects

- Can be very serious on individual trees. Usually attack branch crotch areas. Buying good planting stock and good training pruning can do a lot to limit this problem. Keeping existing plants healthy and out of stress is very important. Can trunk inject specimen trees, but is expensive.

Spruce: - Spruce needle casts (Rhizosphaera)

- Rows of black dots (fruiting bodies) on needles. Loss of innermost needles. Shade and irrigation compound the problem.

- Cytospora canker

- Dieback and eventual death of lower branches. Disease progresses upward in tree over time. Prune out infected branches during dry conditions. Mulching, supplemental watering and fertilization reduce disease incidence.

Crabapple: - Apple scab

- A fungus causing leaf spots, which causes premature leaf drop, and disfigured fruits. Can be treated with two to three foliar sprays annually. Plant disease-resistant varieties.

F. Crew Training

Customized training workshops have been arranged with Wachtel Tree Science to improve the knowledge and confidence of City personnel responsible for maintaining the public trees. December workshops are planned for tree biology and pruning techniques, plus chain saw safety, personal protective equipment and felling techniques. This is part of the current DNR Urban Forestry Grant.

Additionally, some general fund money should be included each year for continued training. Serious consideration should be given to hold at least one membership with the Wisconsin Arborist Association. Attending the various meetings produced by the WAA and/or the DNR's Urban Forestry working group can provide additional avenues to secure technical training. A goal should be to have at least one International Society of Arboriculture *Certified Arborist* on staff.

VII. KEY NEEDS OF THE URBAN FOREST

The main needs of the City of Burlington's urban forest, as brought out in the inventory and discussions, fall into three categories:

Administrative Needs:

- implementation of the Management Plan
- recommendations for additions to the Municipal Tree Ordinance
- supplemental training of crews
- coordinate efforts of all departments currently working with tree issues

- revenue generating opportunities

Resource Needs:

- street tree removals
- safety and clearance pruning
- training pruning
- inspection program for EAB and Dutch elm disease
- increase stocking on streets (planting)
- proper species selection to improve diversity
- improve tree condition/health through timely watering and mulching practices
- proper regular maintenance

Community Needs:

- public awareness on policies of trees in the r-o-w and other public property
- education, especially major disease and insect threats
- involvement of civic groups in funding projects, particularly tree planting

VIII. REVIEW OF PLAN

It is vital to the success of the urban forestry program that this Plan be evaluated to see that desired results are being attained. It has to be remembered that a Management Plan is a dynamic document. There will certainly be a need to change or add goals, strategies and priorities as time goes on. It will be the responsibility of the Department of Public Works and Park Board to review all of the goals, strategies, actions, tasks, and priorities in the Plan in the summer of every year, prior to budget submission, to see that they are achieving the overall Mission and Purpose. Any additions and/or adjustments to the Plan will be made at the time of the review. The Common Council should be informed of these accomplishments. A major review and updating should take place in **2018** by an outside urban forestry consulting firm.

X. CONCLUSION

The City of Burlington has a wonderful living, growing resource. The urban forest needs to be managed to avoid serious problems and to achieve its full potential. When managed properly, it will increase in value, giving many benefits to the citizens from cleaner air, cooler homes, increased property values and just making the City of Burlington a more beautiful community to visit, work and live in.

APPENDIX A

CITY OF BURLINGTON – SPECIES LIST
STREETS and PARKS/MUNICIPAL PROPERTIES

Species Code	COMMON NAME	GENUS	species	Species Class
001	vacant	*VACANT PLANTING SITE*		n. a.
002	stump	*STUMP*		n. a.
068	eastern redcedar	*Juniperus*	*virginiana*	70
091	Norway spruce	*Picea*	*abies*	70
094	white spruce	*Picea*	*glauca*	70
096	Colorado spruce	*Picea*	*pungens*	80
101	pine spp.	*Pinus*	*spp.*	70
125	red pine	*Pinus*	*resinosa*	60
129	eastern white pine	*Pinus*	*strobus*	70
130	Scotch pine	*Pinus*	*sylvestris*	60
136	Austrian pine	*Pinus*	*nigra*	80
202	Douglas-fir	*Pseudotsuga*	*menziesii*	80
221	baldcypress	*Taxodium*	*distichum*	70
241	northern white-cedar	*Thuja*	*occidentalis*	80
310	maple spp.	*Acer*	*spp.*	70
311	amur maple	*Acer*	*ginnala*	90
313	boxelder	*Acer*	*negundo*	10
315	Freeman maple	*Acer*	*freemanii*	80
316	red maple	*Acer*	*rubrum*	70
317	silver maple	*Acer*	*saccharinum*	30
318	sugar maple	*Acer*	*saccharum*	80
320	Norway maple	*Acer*	*platinoides*	60
321	Norway maple var.	*Acer*	*platinoides var.*	70
330	horsechestnut	*Aesculus*	*hippocastenacea*	50
331	Ohio buckeye	*Aesculus*	*glabra*	60
332	yellow buckeye	*Aesculus*	*flava*	80
356	serviceberry	*Amelanchier*	*spp.*	90
370	birch spp.	*Betula*	*spp.*	70
373	river birch	*Betula*	*nigra*	80
375	paper birch	*Betula*	*papyrifera*	50
380	hornbeam spp.	*Carpinus*	*spp.*	80
402	bitternut hickory	*Carya*	*cordiformis*	60
407	shagbark hickory	*Carya*	*ovata*	60
450	catalpa spp.	*Catalpa*	*spp.*	40
462	hackberry	*Celtis*	*occidentalis*	90
471	eastern redbud	*Cercis*	*canadensis*	70
481	yellowwood	*Cladrastis*	*kentukea*	70
493	Cornelian cherry	*Cornus*	*mas*	70
494	pagoda dogwood	*Cornus*	*alternifolia*	70
497	Turkish filbert	*Corylus*	*colurna*	70
500	hawthorn spp.	*Crataegus*	*spp.*	90

APPENDIX A

Species Code	COMMON NAME	GENUS	species	Species Class
541	white ash	*Fraxinus*	*americana*	70
544	green ash	*Fraxinus*	*pennsylvanica*	70
547	European ash	*Fraxinus*	*excelsior*	40
549	Ginkgo	*Ginkgo*	*biloba*	90
553	honeylocust (thornless)	*Gleditsia*	*triacanthos inermis*	70
571	Kentucky coffeetree	*Gymnocladus*	*dioicus*	80
601	butternut	*Juglans*	*cinerea*	50
602	black walnut	*Juglans*	*nigra*	60
621	yellow-poplar	*Liriodendron*	*tuliperfia*	70
660	apple spp.	*Malus*	*spp.*	40
661	crab apple spp.	*Malus*	*spp.*	60
680	mulberry spp.	*Morus*	*spp.*	40
701	ironwood	*Ostrya*	*virginiana*	80
731	sycamore	*Platanus*	*occidentalis*	60
742	eastern cottonwood	*Populus*	*deltoides*	40
743	bigtooth aspen	*Populus*	*grandidentata*	40
746	quaking aspen	*Populus*	*tremuloides*	30
752	white poplar	*Populus*	*alba*	30
760	cherry and plum spp.	*Prunus*	*spp.*	60
762	black cherry	*Prunus*	*serotina*	40
781	Callery pear spp.	*Pyrus*	*calleryana*	80
800	oak spp. -- deciduous	*Quercus*	*spp.*	70
802	white oak	*Quercus*	*alba*	90
804	swamp white oak	*Quercus*	*bicolor*	90
823	bur oak	*Quercus*	*macrocarpa*	90
833	northern red oak	*Quercus*	*rubra*	80
901	black locust	*Robinia*	*pseudoacacia*	30
920	willow	*Salix*	*spp.*	40
940	lilac spp.	*Syringa*	*spp.*	70
941	Japanese tree lilac	*Syringa*	*reticulata*	80
951	American basswood	*Tilia*	*americana*	70
952	Redmond linden	*Tilia*	*amer. 'Redmond'*	80
954	littleleaf linden	*Tilia*	*cordata*	70
970	elm spp. (hybrid)	*Ulmus*	*spp.*	70
972	American elm	*Ulmus*	*americana*	50
974	Siberian elm	*Ulmus*	*pumila*	10
975	red elm	*Ulmus*	*rubra*	50
999	other, unknown	*UNKNOWN*	*UNKNOWN*	70

APPENDIX B

CITY OF BURLINGTON
SPECIES FREQUENCY – ALL PUBLIC TREES

Genus	Common Name	Tree Count	Percentage
Acer	Amur Maple	10	0.22%
Acer	Boxelder	40	0.90%
Acer	Freeman Maple	172	3.85%
Acer	Maple Spp	8	0.18%
Acer	Norway Maple	1110	24.85%
Acer	Red Maple	151	3.38%
Acer	Silver Maple	264	5.91%
Acer	Sugar Maple	165	3.69%
Aesculus	Horsechestnut	1	0.02%
Aesculus	Ohio Buckeye	1	0.02%
Aesculus	Yellow Buckeye	5	0.11%
Amelanchier	Serviceberry	15	0.34%
Betula	Birch Spp.	23	0.52%
Betula	Paper Birch	1	0.02%
Betula	River Birch	19	0.43%
Carpinus	Hornbeam Spp.	7	0.16%
Carya	Bitternut Hickory	1	0.02%
Carya	Shagbark Hickory	20	0.45%
Catalpa	Catalpa Spp.	10	0.22%
Celtis	Hackberry	101	2.26%
Cercis	Eastern Redbud	16	0.36%
Cladrastis	Yellowwood	1	0.02%
Cornus	Cornelian Cherry	1	0.02%
Cornus	Pagoda Dogwood	3	0.07%
Corylus	Turkish Filbert	1	0.02%
Crataegus	Hawthorn Spp.	10	0.22%
Fraxinus	Green Ash	486	10.88%
Fraxinus	European Ash	13	0.29%
Fraxinus	White Ash	322	7.21%
Ginkgo	Ginkgo	5	0.11%
Gleditsia	Honeylocust (Thornless)	343	7.68%
Gymnocladus	Kentucky Coffeetree	7	0.16%
Juglans	Black Walnut	47	1.05%
Juglans	Butternut	1	0.02%
Juniperus	Eastern Redcedar	14	0.31%

APPENDIX B

Genus	Common Name	Tree Count	Percentage
Liriodendron	Yellow-Poplar	4	0.09%
Malus	Apple Spp.	2	0.04%
Malus	Crab Apple Spp.	80	1.79%
Morus	Mulberry Spp.	4	0.09%
Ostrya	Ironwood	4	0.09%
Picea	Colorado Spruce	63	1.41%
Picea	Norway Spruce	29	0.65%
Picea	White Spruce	33	0.74%
Pinus	Austrian Pine	24	0.54%
Pinus	Eastern White Pine	16	0.36%
Pinus	Pine Spp.	1	0.02%
Pinus	Red Pine	12	0.27%
Pinus	Scotch Pine	13	0.29%
Platanus	Sycamore	1	0.02%
Populus	Bigtooth Aspen	1	0.02%
Populus	Eastern Cottonwood	12	0.27%
Populus	White Popular	1	0.02%
Populus	Quaking Aspen	7	0.16%
Prunus	Black Cherry	6	0.13%
Prunus	Cherry and Plum Spp.	13	0.29%
Pseudotsuga	Douglas-Fir	20	0.45%
Pyrus	Callery Pear Spp.	82	1.84&
Quercus	Bur Oak	63	1.41%
Quercus	Northern Red Oak	18	0.40%
Quercus	Oak Spp.	1	0.02%
Quercus	Swamp White Oak	6	0.13%
Quercus	White Oak	32	0.72%
Robinia	Black Locust	16	0.36%
Salix	Willow	5	0.11%
Syringa	Japanese Tree Lilac	29	0.65%
Syringa	Lilac Spp.	1	0.02%
Taxodium	Baldcypress	1	0.02%
Thuja	Northern White-Cedar	69	1.55%
Tilia	American Basswood	61	1.37%
Tilia	Littleleaf Linden	172	3.85%
Tilia	Redmond Linden	91	2.04%
Ulmus	American Elm	12	0.27%
Ulmus	Elm Spp. (Hybrid)	5	0.11%

APPENDIX B

Genus	Common Name	Tree Count	Percentage
Ulmus	Siberian Elm	58	1.30%
UNKNOWN	Other, Unknown	4	0.09%
	TOTALS	4466	100.00%

APPENDIX C

TREE SPECIES RECOMMENDATIONS

This list is provided as a guide to some of the most appropriate trees for urban settings in USDA Hardiness Zone **5a** for the City of Burlington. There is no single perfect tree. These species have been selected for use in our demanding street tree situations. There is a larger group of plants that would grow very well in the City of Burlington and should be considered for other landscape uses (parks, etc.). Before selecting any particular species or variety, each site should be evaluated as to: rooting space, soil texture, soil pH, drainage, exposure, overhead wires, and surrounding buildings (crown space). The most important thing to remember is to plant the right tree in the right place.

SMALL TREES (Below 30' Maximum Height) – Acceptable trees for terraces with overhead power lines and/or if terrace is 3-5 feet wide. May be planted in wider terraces.

Scientific Name	Common Name	Cultivars
Amelanchier arborea	**Downy Serviceberry**	
Amelanchier x grandiflora	**Apple Serviceberry**	'Autumn Brilliance', 'Robin Hill'
Amelanchier laevis	**Allegheny Serviceberry**	'Cumulus', 'Lustre'
Carpinus caroliniana	**American Hornbeam**	'Firespire'
Crataegus crus-galli inermis	**Thornless Cockspur Hawthorn**	
Crataegus phaenopyrum	**Washington Hawthorn**	
Crataegus viridis	**Winter King Hawthorn**	'Winter King'
Maackia amurensis	**Amur Maackia**	'Starburst'
Malus spp.	**Flowering Crabapple**	'Adirondack', 'Bob White', 'Harvest Gold', 'Jackii', 'Prairiefire', 'Professor Sprenger', 'Red Bud', 'Royal Raindrops', 'Sugar Tyme'
Ostrya virginiana	**Ironwood**	
Syringa pekinensis	**Peking Lilac**	'China Snow'
Syringa reticulata	**Japanese Tree Lilac**	'Ivory Silk', 'Summer Snow'

MEDIUM TREES (30'-45' Maximum Height) – Acceptable trees for terraces that are 5-8 feet wide. May be planted in wider terraces.

Scientific Name	Common Name	Cultivars
Aesculus x carnea	**Red Horsechestnut**	'Ft. McNair'
Aesculus glabra	**Ohio Buckeye**	'Sunset'
Cladrastis kentuckea	**American Yellowwood**	
Corylus colurna	**Turkish Filbert**	
Phellodendron amurense	**Amur Corktree (male only)**	'Macho'
Prunus sargentii	**Sargent Cherry**	'Columnaris'
Pyrus calleryana	**Callery Pear**	'Autumn Blaze', 'Cleveland Select'
Sorbus alnifolia	**Korean Mountain Ash**	

Recommended Tree List (cont.)

APPENDIX C

LARGE TREES (Above 45' Maximum Height) – Acceptable trees for terraces 8 foot and wider.

Scientific Name	Common Name	Cultivars
Aesculus octandra	**Yellow Buckeye**	
Carya cordiformis	**Bitternut Hickory**	
Celtis occidentalis	**Hackberry**	'Prairie Pride', 'Chicagoland'
Cercidiphyllum japonicum	**Katsuratree**	
Cladrastis kentuckea	**Yellowwood**	
Eucommia ulmoides	**Hardy Rubber Tree**	
Gingko biloba	**Gingko (male only)**	'Autumn Gold', 'Magyar', 'Princeton Sentry'
Gleditsia triacanthos inermis	**Thornless Honeylocust**	'Imperial', 'Shademaster', 'Skyline', 'Sunburst'
Gymnocladus dioicus	**Kentucky Coffeetree**	'Espresso', 'Prairie Titan'
Liriodendron tulipifera	**Tuliptree**	
Platanus x acerifolia	**London Planetree**	'Exclamation'
Quercus bicolor	**Swamp White Oak**	
Quercus macrocarpa	**Bur Oak**	
Quercus robur	**English Oak**	'Skymaster', 'Regal Prince'
Quercus rubra	**Red Oak**	
Quercus muehlenbergii	**Chinkapin Oak**	
Quercus x schuettei	**Swamp x Bur Oak**	
Taxodium distichum	**Baldcypress**	'Shawnee Brave'
Tilia americana	**American Linden**	'Redmond', 'Sentry'
Tilia x euchlora	**Crimean Linden**	
Ulmus x	**Hybrid Elm**	'Accolade', 'New Horizon', 'Regal', 'Triumph'

Unacceptable Street Tree List

The following is a list of trees that are considered unacceptable for planting in the road right of way. Species on this list may be planted in park or open space settings in the right location and situation. This list should be evaluated periodically and species may be added or removed as seen fit.

Scientific Name	Common Name	Reason
	All Evergreen Species Not on Recommended List	Obstruct visibility, Okay for parks and open spaces
Acer negundo	**Boxelder**	Weak wooded, attracts boxelder bug
Acer platanoides	**Norway Maple**	Over-planted, invasive, girdling roots
Acer rubrum	**Red Maple**	Intolerant of alkaline soils
Acer saccharinum	**Silver Maple**	Weak wooded, aggressive roots, heavy seed crop
Ailanthus altissima	**Tree-of-Heaven**	Weak wooded

APPENDIX C

Betula spp.	**Birch**	Susceptible to insects and disease, intolerant of disturbed sites
Catalpa spp.	**Catalpa**	Littering fruit
Elaeagnus angustifolia	**Russian Olive**	Disease problems, weak wood
Fraxinus spp.	**Ash**	Emerald Ash Borer
Gingko biloba (female)	**Gingko (female)**	Messy and smelly fruit
Juglans spp.	**Walnut**	Littering fruit
Malus sylvestris	**Common Apple**	Fruit tree
Morus spp.	**Mulberry**	Littering fruit
Populus spp.	**Poplar, Cottonwood**	Weak wooded, aggressive roots, heavy seed crop
Prunus serotina	**Black Cherry**	Fruit tree
Prunus domestica	**Garden Plum**	Fruit tree
Pyrus communis	**Common Pear**	Fruit tree
Quercus palustris	**Pin Oak**	Intolerant of alkaline soils
Robinia pseudoacacia	**Black Locust**	Weak wooded, thorns, invasive
Salix spp.	**Willow**	Weak wooded, aggressive roots
Sorbus americana	**American Mountainash**	Susceptible to insects and disease
Sorbus aucuparia	**European Mountainash**	Susceptible to insects and disease
Ulmus pumila	**Siberian Elm**	Weak wooded, aggressive roots

APPENDIX D
Definitions

ANSI: Acronym for American National Standards Institute

ANSI A300 Standards: Industry-developed, national consensus standards of practice for tree care

ANSI Z133.1 Standards: Industry-developed, national consensus safety standards of practice for tree care

Arborist: Professional who possesses the technical competence gained through experience and related training to provide for or supervise the management of trees and other woody plants in residential, commercial, and public landscapes

Best Management Practices (BMP): Best-available, industry-recognized courses of action, in consideration of the benefits and limitations, based on scientific research and current knowledge

Canopy: Collective branches and foliage of a tree or group of trees

Chlorosis: A whitish or yellowish leaf discoloration caused by a lack of chlorophyll, often caused by nutrient deficiency

Co-dominant Branches/Co-dominant Stems: Forked branches nearly the same size in diameter, arising from a common junction and lacking normal branch union

Construction Damage: Damage to a tree (branches, trunk or roots) usually from excavating, filling, grade changes, compaction, etc. It can take up to five years for visible signs of this damage to show up in a tree and ten years for a tree to die.

Crown: Upper part of a tree, measured from the lowest branch, including all the branches and foliage

Crown Cleaning: Removing dead, dying, diseased, and/or broken branches from the tree crown

Crown Rot: Disease or other decay at the base of a tree or root crown

Cultivar: Cultivated variety of a plant; cannot be reproduced without human assistance; usually propagated asexually (cloned); compare to *variety*

DBH: Acronym for diameter at breast height; diameter of a tree measured at 4.5 feet (1.3 meters) above ground

Deadwooding: Removing dead and dying branches from a tree

APPENDIX D
Definitions

Dieback: Condition in which the branches in the tree crown die from the tips toward the center

Directional Pruning: A pruning technique that is used to "train" trees to grow in a certain direction (usually away from utility lines or buildings). The most important aspect involves always pruning back to a lateral branch to try and reestablish a leader in that area of the tree.

Flagging: Symptom in which leaves on a branch wilt and may ultimately turn brown without falling from the shoot

Genus: Taxonomic group of species having similar fundamental traits: botanical classification under the family level and above the species level

Girdling Roots: Roots located above or below ground whose circular growth around the base of the trunk or over individual roots applies pressure to the bark area, ultimately restricting sap flow and trunk/root growth, frequently resulting in reduced vitality and/or death of the plant.

Hanger: Broken or cut branch that is hanging in a tree

Hardiness: Genetically determined ability of a plant to survive low temperatures

Hazard Tree: Any tree or tree part that has a major structural fault that could lead to catastrophic loss and it has an identifiable target (people or property).

Included Bark: Bark that becomes embedded in a crotch (union) between branch and trunk or between codominant stems; causes a weak union

Leader: Primary terminal shoot or trunk of a tree; large, usually upright stem; a stem that dominates a portion of the crown by suppressing lateral branches

Live Crown Ratio: Ratio of the height of the crown containing live foliage to the overall height of the tree

Mature Height: Maximum height that a plant is likely to reach if the conditions of the planting site are favorable

Pruning Cycle: In municipal arboriculture, the length of time between each maintenance (routine) pruning for a given geographic area

Raising: Selective removal of lower limbs from a tree to provide clearance; Lifting

Root Crown: Area where the main roots join the plant stem, usually flared at the tree trunk base; Root Collar

APPENDIX D
Definitions

Routine Pruning: Pruning done on a regular basis (usually every 5-7 years) that is done mostly for sanitation, therapeutic or maintenance reasons to keep trees healthy. Usually involves a combination of crown cleaning, raising and training pruning.

Safety Pruning: Pruning to remove a potential hazard such as large deadwood, broken branches, or branches impeding traffic or pedestrian travel. This type of pruning also includes branches obstructing street signs and light or obstructing vision at intersections and drive approaches.

Significant Trees: Trees that are unique due to historical reasons or are rare specimens due to the species, size, age or location.

Species: Taxonomic group of organisms composed of individuals of the same genus that can reproduce among themselves and have similar offspring

Structural Defects: Any naturally occurring or secondary conditions such as cavities, poor branch attachments, cracks, or decayed wood in the trunk, crown, or roots of a tree that may contribute to structural failure

Training Pruning: Pruning done to young trees (or sometimes neglected older trees) to establish proper branching structure, critical for long term health and safety of trees. Best if performed on a 3 - 4 year cycle.

Trunk Formula Method: Method to appraise the monetary value of trees considered too large to be replaced with nursery or field-grown stock, or a method to produce a fairly accurate monetary value of a large grouping of public trees

Watch Tree: These are trees that need to be checked yearly due to problems such as poor structure or decay. These are marginal trees that are not bad enough to make the safety prune or removal list, but due to their condition, they may need work in the next few years. They have a higher potential for problems and should be checked regularly due to this.

Utility Prune: Pruning around or near utility facilities with the objective of maintaining safe and reliable utility service

Variety: Naturally occurring subdivision of a species having a distinct difference and breeding true to that difference; compare to *cultivar*

APPENDIX E

REFERENCES & RESOURCES

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***** = Add to City's best practices manual

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APPENDIX F

WEBSITES FOR INFORMATION ON TREES

Wisconsin's Emerald Ash Borer Resource http://emeraldashborer.wi.gov/

The WI EAB Resource is brought to you by:
- -WI Department of Agriculture, Trade and Consumer Protection
- -Wisconsin Department of Natural Resources
- -University of Wisconsin - Madison

Visit their EAB Web pages for additional information on EAB.

Wisconsin's Gypsy Moth Resource http://www.gypsymoth.wi.gov/

Insect Diagnostic Lab, UW-Madison http://www.entomology.wisc.edu/entodiag.html

Plant Disease Diagnostic Clinic, UW-Madison http://www.plantpath.wisc.edu/pddc/

UW-Extension Urban Horticulture http://www.uwex.edu/ces/wihort/

Most complete source of horticulture information for Wisconsin on the Internet including Garden Fact Sheets

Guidelines for Healthy Trees http://www.ina-online.org/treespecs.htm

Prepared by the Illinois Tree Specifications Review Committee

Selecting Urban Trees and Shrubs http://www.na.fs.fed.us/spfo/pubs/UF/uts/

- -Produced by the Chicago Botanic Garden
- -Slide assistance provided by the school of Forest Resources, Pennsylvania State University.
- -Funding provided in part by the USDA Forest Service, Northeastern, Area State and Private Forestry, Midwest Center for Urban and Community Forestry

Tree Care Information http://www.treesaregood.org/

Sponsored by the International Society of Arboriculture

Benefits of Trees	Value of Trees
New Tree Planting	Why should I hire an arborist?
Find a Tree Care Service	Frequently Asked Questions
Quick Facts about Trees	Resources

Wisconsin Arborist Association http://www.waa-isa.org/

Search for Certified Arborists for Hire

APPENDIX G

SPECIAL CONDITIONS

ABBREVIATIONS CODE

BS	Basal Suckers
BW	Basal Wound
CC	Concreted Cavity
C/D	Cavity/Decay
CD	Crown Dieback
CR	Consider Removal
CT	Codominant Trunks/Stems
DFP	Decay Fungi Present
DL	Dead Leader
DP	Deep Planting
DW	Deadwood (2"+)
HG	Hanger
IA	Invasives Around
IB	Included Bark
IM	Improperly Mulched
IP	Improperly Pruned
LB	Low Branched
LC	Low Crotched
LLD	Large Leader Decay
LML	Lost Main Limb/Leader
LN	Leaning
LS	Lightning Struck
MD	Mechanical Damage
MS	Multi-stemmed
ND	Nutrient Deficiency
OG	Overgrowing Growspace
OS	Overshadowed
PL	Poor Location
PP	Pest Problem
PS	Poor Structure
RD	Root Damage
RP	Raised Planter
RR	Root Rot
SP	Suckers Present
TP	Topped
TS	Trunk Split
TW	Trunk Wound
UP	Utility Pruned
WA	Wooded Area
WG	Weak Growth

APPENDIX H
Sample Tree Protection Provisions

Intent

These provisions are intended to provide standards and guidelines for the preservation of trees as part of the land development and/or building construction process. The City of Burlington finds that such preservation is necessary to promote the general health and welfare of the community by making the City a more attractive place to live, protect watercourses and ecology, provide a healthy living environment, and to better maintain control of flooding, noise, glare, and soil erosion. The City further finds that trees provide beneficial oxygen while reducing the levels of harmful carbon dioxide and reduce air pollution, purify water, and stabilize soil. Trees also provide wildlife habitat and shade, cool the land, reduce noise, and provide an aesthetic value to the land.

Definitions

Certified Arborist: An individual who is trained in the art and science of planting, caring for and maintaining individual trees. And one who has passed the certification examination sponsored by the International Society of Arboriculture and who maintains a current certification.

Diameter-at-Breast-Height (DBH): A standard measure of tree trunk size measured at 4.5' above ground level, on the uphill side.

Qualified Arborist: A worker who, through related training and on-the-job experience, is familiar with the hazards of pruning, trimming, repairing, maintaining, or removing trees, and with the equipment used in such operations, and has demonstrated his/her ability in the performance of the special techniques involved

Specimen Tree(s) or Stand: Any tree or group of trees which has been determined to be of high value because of its species, size, age, historic significance or other criteria as designated by the City of Burlington.

Tree Protection Zone (TPZ): A fenced area around a tree or group of trees that will not be disturbed by construction activities.

DPW: Individuals in charge of enforcing the provisions of these specifications.

Sample - Specimen Tree List - City of Burlington

SPECIES	Min. DBH	SPECIES	Min. DBH
American Basswood	20"	Common Hackberry	16"
Sugar Maple	12"	American Beech	12"
All Serviceberries	6"	All Oaks	12"

APPENDIX H
Sample Tree Protection Provisions

SPECIES	Min. DBH	SPECIES	Min. DBH
Musclewood	6"	White Pine	12"
All Hickories	12"	Butternut	12"
Black Walnut	12"	Black Cherry	12"
Eastern Red Cedar	8"	Ironwood	6"
Tamarack or Larch	12"	White Cedar	12"
Kentucky Coffeetree	12"		

Calculating the Optimal Tree Protection Zone

1. Evaluate the species tolerance of the specimen tree: good, moderate, or poor (see Table 1).

2. Identify specimen tree age: young, mature, or overmature.

3. Using Table 2, find the distance (in feet) from the trunk that should be protected per inch of trunk diameter.

4. Multiply the distance by the trunk diameter to calculate the optimum radius (in feet) for the tree protection zone.

Examples

A healthy 50-year-old, 15” diameter Northern Red Oak (*Quercus rubra*) (good tolerance, mature age):

0.75’ x 15” = 11.25’ radius for Tree protection zone

A declining 90-year-old, 26” diameter Shagbark hickory (*Carya ovata*) (intermediate tolerance, overmature age):

1.25’ x 26” = 32.5’ radius for Tree protection zone

The tables and formulas are strictly guidelines, not an absolute rule, and may need to be adjusted in the field to meet local conditions and design criteria. It is best and least expensive to protect trees in groupings during construction. Groupings offer the best protection for soil, root systems and associated plants.

APPENDIX H
Sample Tree Protection Provisions

Table 1. Size and Tolerance of Tree Species to Construction Impacts.

This table represents information from three publications: *Tree Characteristics, Protecting Trees from Construction Damage*, Minnesota Extension Service, University of Minnesota; *The Response of Ohio's Native and Naturalized Trees to Construction Activity*, T. Davis Sydnor, School of Natural Resources, The Ohio State University; and *Relative Tolerance of Tree Species to Construction Damage*, Kim D. Coder, The University of Georgia Cooperative Extension Service, Forest Resources Unit.

Tolerance to construction impact can vary greatly according to site characteristics such as soil depth, individual tree characteristics such as rooting habit, prevailing weather conditions such as drought, and the degree of construction impact.

SPECIES	ROOT SEVERANCE	SOIL COMPACTION AND FLOODING	MATURE CROWN SPREAD (FEET)	HAZARD POTENTIAL RATING*	COMMENTS
Norway Spruce	tolerant	tolerant	20-30	medium	vulnerable to windthrow
Colorado Spruce	intermediate	tolerant	20-30	medium	vulnerable to windthrow
White Pine	tolerant	sensitive	40-60	medium	sensitive to drainage changes
Austrian Pine	tolerant	sensitive	30-50	medium	sensitive to poor drainage
Scotch Pine	tolerant	sensitive	30-50	medium	sensitive to poor drainage
Tamarack or Larch	tolerant	tolerant	15-25	medium	
Red Cedar	tolerant	sensitive	10-20	low	
White Cedar	tolerant	tolerant	10-20	low	
All Firs	tolerant	sensitive	10-20	medium	
Horsechestnut	sensitive	sensitive	30-40	medium	
Kentucky Coffeetree	intermediate	intermediate	40-50	medium	
Butternut	sensitive	sensitive	50-60	medium	
Redbud	intermediate	intermediate	25-35	low	sensitive to increased light and heat
All Mulberries	tolerant	tolerant	35-50	high	
Sycamore	tolerant	tolerant	60-80	low	
Pagoda Dogwood	intermediate	intermediate	15-20	low	sensitive to increased light and heat
Ironwood	sensitive	sensitive	20-30	low	
Musclewood	sensitive	sensitive	20-30	low	
All Hickories	intermediate	sensitive	30-40	medium	
Amur Corktree	intermediate	intermediate	30-40	medium	
Hackberry	tolerant	intermediate	40-50	low	
Ohio Buckeye	sensitive	sensitive	30-40	medium	
Catalpa	intermediate	tolerant	30-50	medium	
Bur Oak	tolerant	tolerant	40-80	low	
Red Oak	tolerant	sensitive	40-50	low	
White Oaks	sensitive	sensitive	50-90	low	
Sugar Maple	tolerant	sensitive	60-80	medium	sensitive to fill
Red Maple	tolerant	tolerant	40-60	medium	sensitive to wounding
Norway Maple	tolerant	tolerant	60-80	medium	
Black Cherry	intermediate	sensitive	40-50	low	
White Ash	tolerant	intermediate	40-70	medium	
All Serviceberries	intermediate	intermediate	15-20	low	
American Beech	sensitive	sensitive	30-50	medium	sensitive to fill

APPENDIX H
Sample Tree Protection Provisions

SPECIES	ROOT SEVERANCE	SOIL COMPACTION AND FLOODING	MATURE CROWN SPREAD (FEET)	HAZARD POTENTIAL RATING*	COMMENTS
European Beech	sensitive	sensitive	40-60	medium	sensitive to fill
Honeylocust	tolerant	tolerant	50-75	medium	
Black Walnut	sensitive	intermediate	50-70	medium	

***Hazard Potential Rating** refers to the relative potential for a tree to become hazardous due to its large size and likelihood of breakage or decay. For a tree to be considered hazardous, a likely "target" (e.g., a person, a house, or car) must be present. A high rating does not imply that an individual tree is likely to fail.

TABLE 2. Guidelines for Tree Protection Zones

Distances to be increased for trees of poor vigor and to protect young and other trees with low branching from severe pruning of limbs. Table adapted from table provided courtesy of the International Society of Arboriculture

SPECIES TOLERANCE TO IMPACTS	TREE AGE	DISTANCE FROM TRUNK* (feet per inch of DBH)
tolerant	young <1/4 life expectancy	0.5'
	middle aged 1/4 - 3/4 life expectancy	0.75'
	mature >3/4 life expectancy	1.0'
intermediate	young	0.75'
	middle aged	1.0'
	mature	1.25'
sensitive	young	1.0'
	middle aged	1.25'
	mature	1.5'

* These distances are based on a tree's tolerance to root pruning and soil disturbance and may not be adequate to protect branches of young trees or other trees with low branching. Because severe pruning would destroy the form of such trees, fencing at the dripline or beyond is required.

APPENDIX H
Sample Tree Protection Provisions

Site Clearing Specifications

The following work must be accomplished before any demolition or site clearing activity occurs within 50 feet of specimen trees:

1. The site clearance/demolition contractor is required to meet with the DPW at the site prior to beginning work to review all work procedures, access and haul routes, and tree protection measures.

2. Limits of all TPZ(s) shall be staked by the contractor in the field. A 4-foot plastic, wood or chain link fence with posts sunk in the ground at no more than 10' on center shall be erected to enclose each TPZ. Weather resistant signs with the wording: KEEP OUT – TREE PROTECTION ZONE shall be erected by the contractor at each TPZ. Signs shall be placed a minimum of 30' on center on the TPZ fencing. Each TPZ shall have a minimum of one sign.

3. Tree(s) to be removed that have branches extending into the canopy of tree(s) to remain must be removed by a qualified arborist and not by demolition or construction contractors. The qualified arborist shall remove the tree in a manner that causes no damage to the tree(s) and understory to remain.

4. Any brush clearing required within the TPZ shall be accomplished by a qualified arborist using hand-operated equipment.

5. Trees to be removed shall be felled so as to fall away from TBZ(s) and to avoid pulling and breaking of roots to remain.

6. Trees to be removed within the tree protection zone shall be removed by a qualified arborist. The trees shall be cut near ground level and the stump ground out.

7. All downed brush and trees shall be removed from the TPZ either by hand or with equipment sitting outside the TPZ. Extraction shall occur by lifting the material out, not by skidding it across the ground.

8. Brush shall be chipped and hauled offsite or stored to be used as a buffer over root zones.

9. Structures and underground features to be removed within the TPZ shall use the smallest equipment possible and operate from outside the TPZ. The DPW shall be on site during all operations within the TPZ to monitor demolition activities.

10. All trees to be pruned in accordance with the provided Pruning Specifications.

APPENDIX H
Sample Tree Protection Provisions

11. Any damage to trees due to clearing or demolition activities shall be reported to the City Forester within 6 hours so remedial action can be taken. Timeliness is critical to tree health.

12. If temporary haul or access roads must pass over the root areas of trees to be retained, a roadbed shall be constructed by laying appropriate geo-textile fabric on the surface and covering with 8 inches of mulch or gravel to protect the soil from compaction. The road bed material shall be replenished as necessary to maintain an 8-inch depth.

Pruning Specifications

1. All pruning shall be performed by a qualified arborist under the direct, on-site supervision of a Certified Arborist.

2. All pruning shall be in accordance with the ANSI A300 Pruning Standard (American National Standard for Tree Care Operations) and adhere to the most recent edition of ANSI Z133.1 Safety Requirements for Tree Care Operations.

3. Where temporary clearance is needed for access, branches shall be tied back to hold them out of the clearance zone.

4. Pruning shall not be performed on Oaks or Elms during the time period of April 15th thru September 1st due to the potential spread of Oak Wilt and Dutch Elm disease.

5. Interior branches shall not be stripped out.

6. Pruning cuts larger than 4 inches in diameter, except for deadwood, shall be avoided.

7. No more than 20 percent of live foliage shall be removed within the trees.

8. Brush shall be chipped and chips shall be spread underneath trees within the TPZ to a maximum depth of 6 inches, leaving the trunk clear of mulch.

Construction Specifications

1. Before beginning work, the contractor is required to meet with the DPW at the site to review all work procedures, access routes, utility corridors, storage areas, and tree protection measures.

2. Fences have been erected and sign have been posted to protect trees to be preserved. Fences define a specific protection zone for each tree or group of trees. Fences and signs are to remain until all site work has been completed. Fences or signs may not be relocated or removed without the permission of the DPW.

3. Construction trailers and traffic and storage areas must remain outside fenced areas at all times.

4. All underground utilities and drain or irrigation lines shall be routed outside the TPZ. If lines must traverse the protection area, they shall be tunneled or bored under the tree. (See Table 3) Utilities shall be placed in a common trench where practical. Soil removed from trenches shall be placed on the side away from trees and replaced as soon as possible. Trench walls shall be shored rather than sloped to reduce trench width.

Table 3. Trench Augering Distances

The distance from tree face for augering in each direction if trench is located within a particular radius of a TPZ (Morell 1984).

Tree Diameter (DBH)	Auger distance from face of tree
0-2"	1'
3-4"	2'
5-9"	5'
10-14"	10'
15-19"	12'
over 19"	15'

5. No materials, equipment, spoil, or waste or washout water may be deposited, stored, or parked within the TPZ.

6. Additional tree pruning required for clearance during construction must be performed by a qualified arborist and not by construction personnel.

7. Any herbicides placed under paving materials must be safe for use around trees and labeled for that use. Any pesticides used on site must be tree-safe and not easily transported by water.

8. If injury should occur to any tree during construction, it should be evaluated as soon as possible by the DPW so that appropriate treatments can be applied.

9. Any grading, construction, demolition, or other work that is expected to encounter tree roots must be monitored by the DPW. Specific locations or tree tag numbers shall be identified prior to work commencing.

10. Erosion control devices such as silt fencing, debris basins, and water diversion structures shall be installed to prevent siltation and/or erosion within the TPZ.

APPENDIX H
Sample Tree Protection Provisions

11. Before grading, pad preparation, or excavation for foundations, footings, walls, or trenching, specimen tag # trees, shall be root pruned 1 foot outside the TPZ by cutting all roots cleanly to a depth of 36 inches, normal depth of root penetration. Roots shall be cut manually digging a trench and cutting exposed roots with a saw, vibrating knife, rock saw, a narrow trencher with sharp blades, or other approved root-pruning equipment.

12. Any roots damaged during grading or construction shall be exposed to sound tissue and cut cleanly with a saw or other appropriate sharp cutting instrument.

13. If temporary haul or access roads must pass over the root areas of trees to be retained, a roadbed shall be constructed by laying appropriate geo-textile fabric on the surface and covering with 8 inches of mulch or gravel to protect the soil from compaction. The road bed material shall be replenished as necessary to maintain an 8-inch depth.
14. Spoil from trenches, basements, or other excavations shall not be placed within the TPZ, either temporarily or permanently.

15. No burn piles or debris pits shall be placed within the TPZ. No ashes, debris, or garbage may be dumped or buried within the TPZ.

16. Maintain fire-safe areas around fenced areas. Also, no heat sources, flames, ignition sources, or smoking is allowed near mulch or trees.

Grading

1. Maintain the root flare at the bottom of trees. Do not bury the trunk flare.

2. For small grade changes (1 to 2 feet) slope to natural grade rather than construct a retaining wall. For larger grade changes, retaining walls can increase the distance of natural grade and therefore should be considered.

3. Within or in close proximity to a TPZ, adjust surrounding grades to match base trunk elevation as closely as possible.

4. Where grade must be raised, determine the location of the proposed structure on the fill area, plus required overbuild. If within a TPZ, a retaining wall may be required at that location.

5. If TPZ is in a low area that will collect water, a drain shall be installed as far from the tree as possible, near the retaining wall. Fine grade the area by hand to create flow to the drain.

6. Where required grade changes prohibit the establishment of an adequate TPZ, the tree/trees shall be removed and replanting of appropriate trees (per mitigation requirements). Planting for that location shall be performed after final grades are installed.

APPENDIX H
Sample Tree Protection Provisions

Mitigation Requirements for Specimen Trees

1. Report any damage or injury to specimen trees within 6 hours to the DPW so that mitigation can take place.

2. If inadvertent compaction occurs in the upper 12" of soil within the TPZ, the soil shall be loosened by a method approved by the DPW, such as vertical mulching or soil fracturing.

3. Irrigate to wet the soil within the TPZ during periods of drought as specified by the DPW.

4. Where roots 2" and larger are encountered in trenches, they must be cleanly cut back to a sound lateral root. All exposed root areas within the TPZ shall be backfilled or covered within one hour. If this cannot be accomplished, then the roots shall be covered with layered wet burlap until backfilling can occur to reduce evaporation from trench walls.

5. If bark or trunk wounding should occur, current bark tracing and treatment methods shall be performed by a qualified arborist within two days.

6. Where injury occurs to branches, within 5 days, the broken or torn branch shall be cut back to an appropriate branch capable of resuming terminal growth. Work shall be performed by a qualified arborist. If foliage is heat scorched from equipment exhaust pipes, the DPW shall be informed within 6 hours.

7. Where a specimen tree is removed by design or error, replacement shall be at a ratio of 1" of DBH of replacement for every 1" of DBH of removal. Replacement trees shall be of a size and species as determined by the City of Burlington.

8. If a specimen tree incurs significant damage to its roots, bole or crown, the DPW will determine the Tree Appraisal value. This will be determined by adjusting the tree's basic value by its species, location and condition using the most recent edition of the *Guide for Plant Appraisal*, published by the Council of Tree and Landscape Appraisers. The formula and appraisal methods used shall be noted.

Alternative Construction Techniques

1. Where grades are to be raised, excavation towards trees is minimized with L-type footings, with the L of the footing extending towards the fill and away from the tree. In cuts, the footing shall extend towards the cut and away from the tree.

2. For grade changes over 5 feet, two or more smaller retaining walls shall be considered and stepped down the slope to reduce the mass of a larger single wall.

3. Where structures must be placed close to a TPZ, alternative footing designs shall be considered. These include: the use of custom footings in the vicinity of trees that bridge over tree roots; cantilevering the structure, so the building extends outward from the footing; and installing a raised foundation with discontinuous footings (piers).

Aftercare

1. Avoid putting trees in stress for several years after construction. Water during periods of drought and treat for insect and disease infestations when they arise.

2. Contact a Certified Arborist about whether fertilizing trees is appropriate. Be sure not to overdo it. Trees with damaged roots can't take up and utilize excessive amounts of fertilizer. Also consider mycorrhizae applications to assist with root regeneration and Cambistat (a plant growth regulator) to redirect the root to shoot ratio to producing more root growth.

3. Aerate compacted soils if there are large trees on the site where roots are growing in compacted areas of the site. Aeration can be done to shallow depth with standard core aerators or to deeper depths by vertical mulching with air spades or gas powered augers.

3. If root damage or loss should occur, estimate the percentage of damage or loss and thin out the top in direct proportion to root loss.

4. Protect root zones of both existing and newly planted trees with 3 to 4 inches of organic mulch. Keep mulch several inches away from the trunk base and mulch all the way to the dripline where feasible.

5. Keep competing vegetation especially grass away from trees. Consider alternative landscaping in the areas beneath trees. Use native plants and groundcovers that can provide a variety of sizes, colors and forms beneath preserved trees. These plantings preserve tree root systems, conserve water and reduce the reliance on fertilizers and pesticides.

References

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APPENDIX H
Sample Tree Protection Provisions

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APPENDIX I
Arboricultural Diagrams

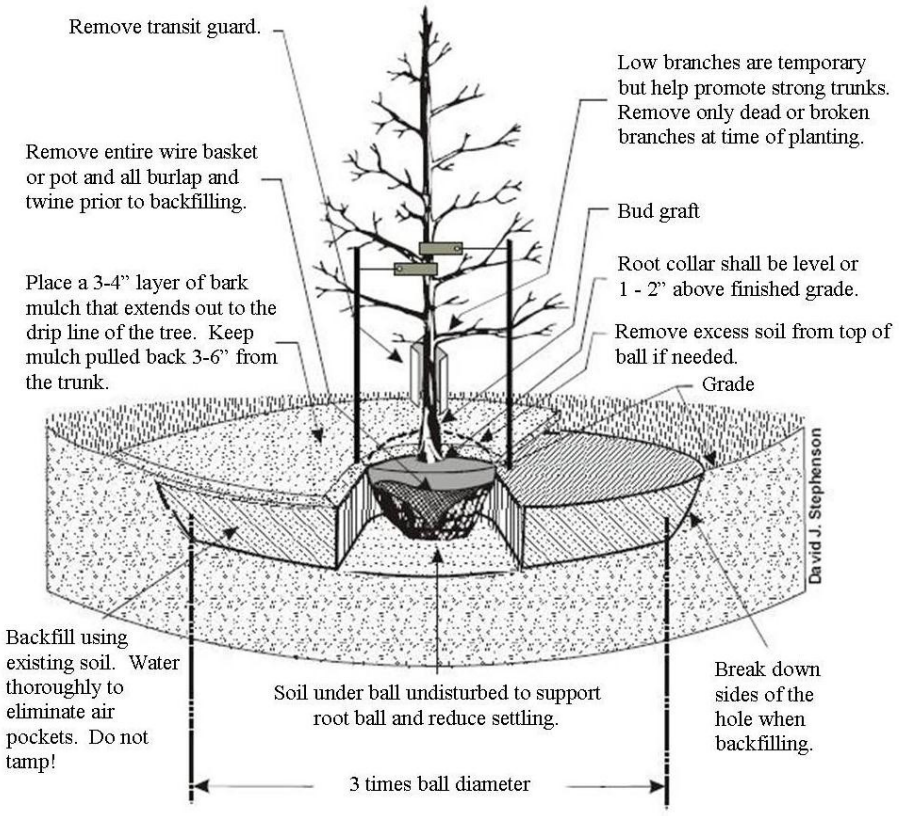

Figure 1 – Tree Planting Detail

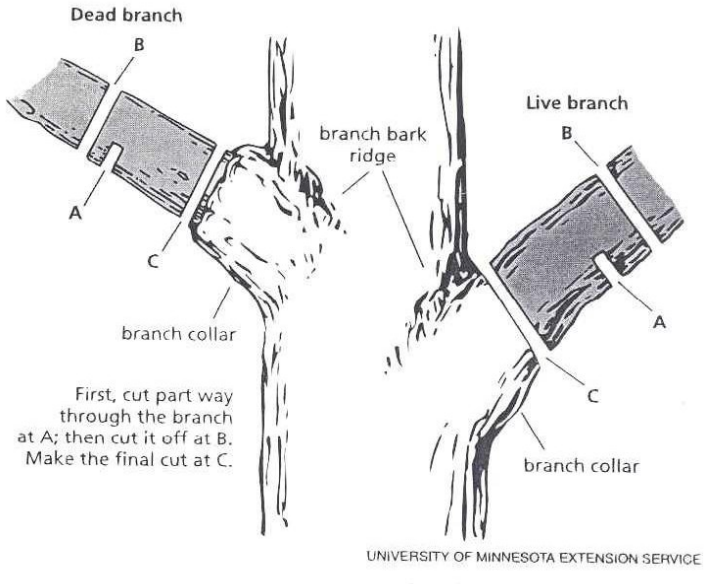

Figure 2 – Proper Pruning Technique

APPENDIX I
Arboricultural Diagrams

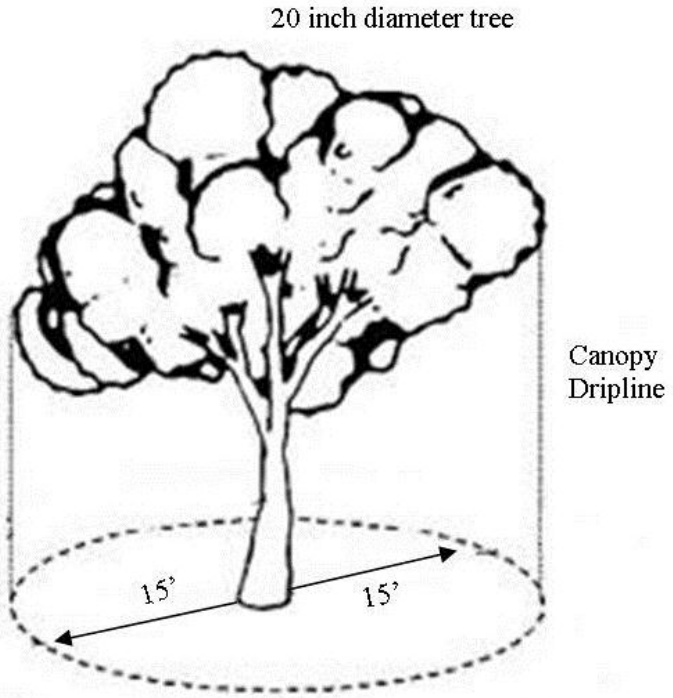

Figure 3 – Extent of Tree Protection Zone

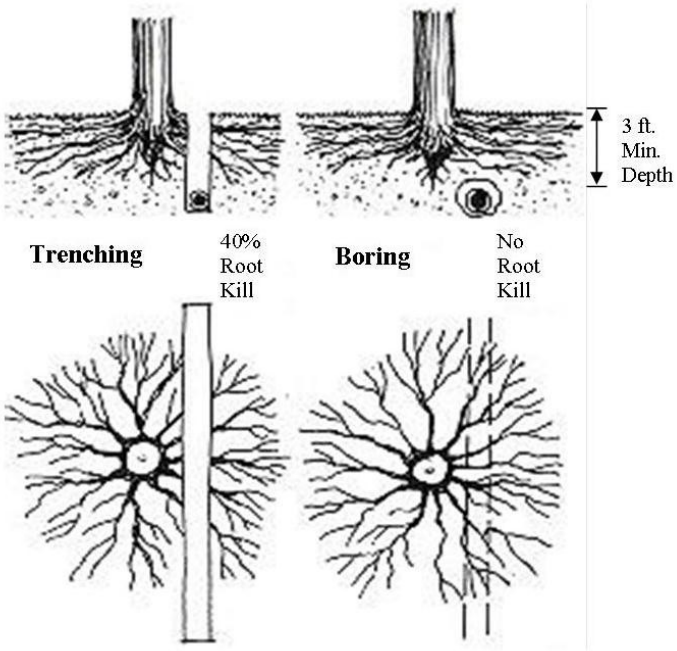

Figure 4 – How Boring Saves Trees